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ARCHÆOLOGY.

ARCHÆOLOGICAL EXPLORATIONS IN TENNESSEE.

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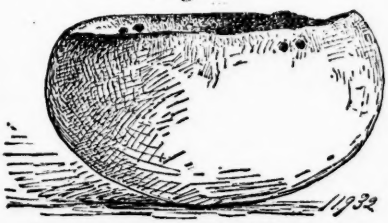
(*Continued.*)

With these articles of pottery should be mentioned the ring, made of the same material, which was found in contact with an under jaw, in one of the graves; also the pipe, of which figure 21 is a representation of full size. This was the only pipe found in the mound, and only two or three others, all of this material and shape, were obtained from the other mounds on Miss Bowling's farm.

Among the articles of special interest found in the graves, were three rings of nearly uniform size, though made of different materials. One of these (Fig. 22) is made of a hard, green steatite, and is represented of actual size. It is perfectly symmetrical and highly polished, one and three-quarters inches in diameter and three-quarters of an inch wide. As shown by the figure, the central portion of the outer surface is cut out so as to leave a ridge around each

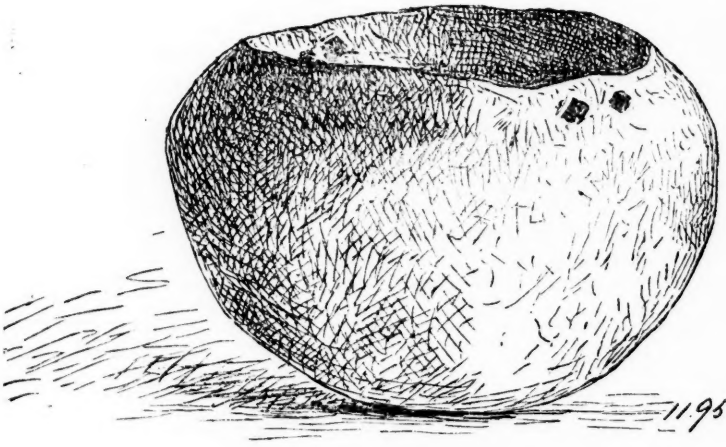
Fig. 12.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

edge. The inner surface is slightly convex, the edges being rounded outwards. A similar ring of steatite of about the same size, from Pennsylvania, has been figured by Mr. Rau; and a few others, made of various materials, have been found in mounds and on the surface. The specimen here figured was in close contact with the under jaw of the elderly person buried in the grave, and in the same grave, near its center, was another ring, made of slate. This second specimen is one-eighth of an inch less in diameter and in width, than the one made of steatite, and differed from that simply in not having the projecting rims, it being perfectly flat and smooth on its outer surface.

Fig. 13.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

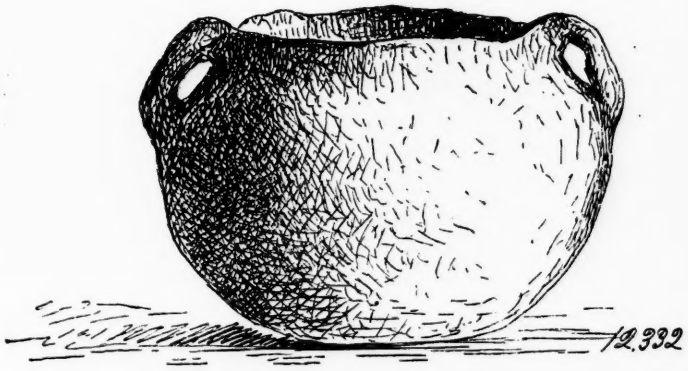
Fig. 14.

Vessel from Stone-grave Mound, Miss Bowling's farm. Natural size.

The third example of these rings is made of well burnt pottery, and while it is of the same external diameter as the one made of

steatite, the thickness is slightly less. The width is the same as the one figured, and its outer surface is flat, like the specimen made of slate. This pottery ring, like the one made of steatite, was found in a grave and close to an under jaw.

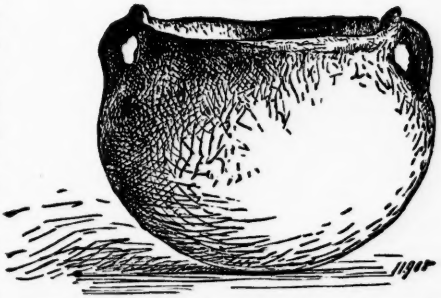
Fig. 15.



Vessel from Stone-grave Mound, Miss Bowling's farm. Natural size.

From the fact that two of the three rings were found in the position stated, it may be surmised that they were labrets, and were in the lips of the individuals when buried. Their size is not as large as some labrets that have been described as used by Indians of the north-western coast; therefore there is no objection to the theory on account of the size of the rings, although, as they were found in only two of the many graves, their scarcity indicates they were not in common use. Of course, these rings may have been for an entirely different purpose than I have suggested, and the contact of two of them with the under jaws may have been accidental.

Fig. 16.



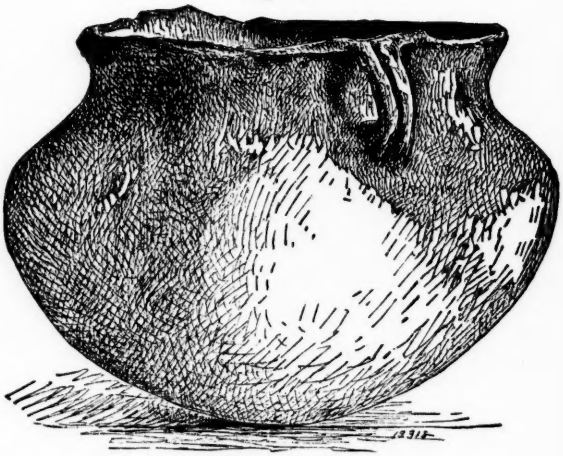
Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

Implements made of stone, though often found on the surface in the vicinity of the old cemeteries of the Cumberland Valley, were not very abundant in these mounds, and were seldom found in the graves.

Out of thirty-one chipped implements obtained from the mounds on Miss

Bowling's farm, explored for the Museum, only five were found in the graves. The position of the others among the graves, however, shows that, like many of the articles of pottery, these stone implements had been left upon, or by the sides of, the graves, and hence are contemporaneous with them.

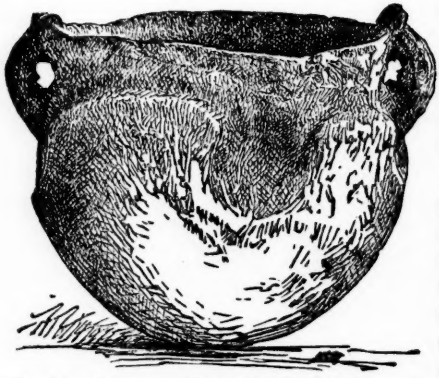
Fig. 17.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

The chipped implements are of the several varieties of horn-stone and jasper, of which the majority of such articles found in the Southern and Western States are made. They are of various sizes, patterns and perfection of finish, such as are usually found together. One of the largest of these, which can be regarded as a knife, scraper, dagger, or spear-point, as fancy may incline, is represented of natural size (Fig. 23). This was found in grave 15, with several other articles, as already mentioned. Two other large implements (12339) would be classed as scrapers. They are five inches long and from two to two and a half wide.

Fig. 18.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

One of them is made from a piece of black horn-stone, which has an impure nodule on one side that must have proved far less tractable to the worker than the rest of the stone, and may indicate that the scraper was used without a handle of wood, for the nodular part fits well to the palm of the hand and allows the opposite side to be freely used when so held.

The other scraper is made of a gray horn-stone, and its highly polished edges

and surfaces show that it had long been used, probably, simply as a hand-stone.

A still ruder form of scraper (11959), of the same material as the last, was found between the graves. This specimen is three and three-quarters inches in length by two and a quarter in width, and nearly an inch in its greatest thickness. It is as rudely made as many of the implements from the gravel bed at Trenton, described by Dr. Abbott, although of a material which is easily worked into delicate forms.

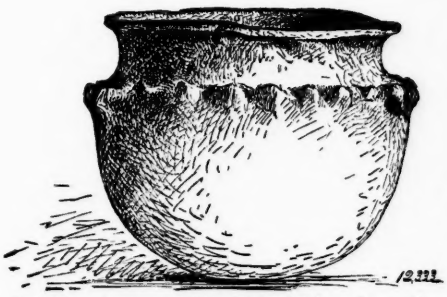
Fig. 19.

Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

Another specimen (12338), of a light mottled gray hornstone, is a well made scraper with a beveled edge, and its size is such as to suggest that it had been attached to a handle. It is two and three-quarters inches long by one and a half across the beveled portion, the scraping edge of which is slightly convex. The opposite end of the implement is somewhat pointed and thinner at the edges.

From the scraper last described, the transition is easy to a small leaf-shaped implement of similar material, carefully chipped to a point and thin edges. This implement (12340) is an inch and three-quarters long, not exceeding in its greatest width three-quarters of an inch, flat on one surface and having a ridge along the opposite center. While it might be classed as a leaf-shaped arrow-point, it is more likely to have been mounted on a short handle for use as a knife, for which it is well adapted by its shape, point and edges.

Fig. 20.



Vessel from Stone-grave Mound, Miss Bowling's farm. ½.

An implement of a gray hornstone, three and three-fourths inches long, one inch in width and one-half an inch in thickness in the center, is interesting from its rather unusual shape, being pointed at both ends and decreasing in thickness in all directions from the center to the cutting edges. This was

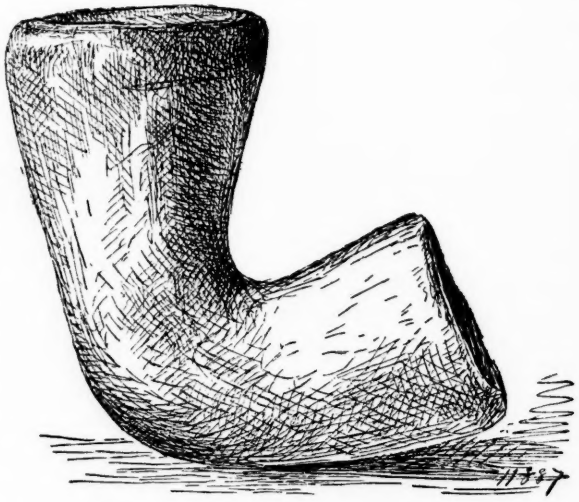
found in the dirt between the graves, and is No. 12339 in the Museum catalogue. It is, in shape, like the implement figured by Prof. Jones (p. 138, fig. 75), but only about one-quarter of the size.

Passing to the spear-points, knives and arrow-points, there are several of interest, a few of which were taken from the graves.

The largest of these is a well-made, symmetrical spear-point (11958), four inches long, one and three-fourths in greatest width, and one-fourth of an inch thick at its expanded base, which is perfectly straight and flat. The stem is slightly notched.

Another specimen (12337), as long as the one just described, is somewhat thicker, but only one and one-fourth inches wide. This has a narrow stem without side notches.

Fig. 21.



Pipe of Pottery, from Stone-grave Mound, Miss Bowling's farm. Natural size.

Ranging between these spear-points and the small arrowheads, are ten perfect and several broken implements that may be classed either as spear-points, knives, or arrow-points. The largest of these (11957), and the only one having an approach to barbs, is shown in figure 24, of actual size. As will be seen by the figure, this is not a symmetrical implement, and its shape is such as to suggest its use as a knife, or dagger-point.

Two specimens, (12336–7) are about half the size of the last. One of these has a perfect and delicate point, and is slightly notched on the sides of the stem. Seven others are of various sizes and widths, between two and one-half and three inches in length, and all have short, straight, or slightly notched stems. One of these (12336, *a*) is much thinner and broader, in proportion to its length, than any of the others, and, mounted on a handle, would form a cutting instrument of no mean character.

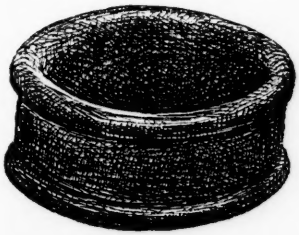
Of three specimens from an inch and a quarter to an inch and a half in

length, that were probably arrow points, one (12341) has a fine point, an expanded and slightly convex base, and a notched stem. Another (12341, *a*) has a straight stem and a proportionally longer and more slender point. The third (11890) is short and broad, with a convex base, and that peculiarly shaped and abruptly made point which gives the impression that it was a broken specimen re-pointed.

Among the clipped implements of flint, was one that would probably be classed with the drills, or perforators. This was found in a grave, and is represented, of natural size, in figure 25.

Stone axes and celts have not often been found

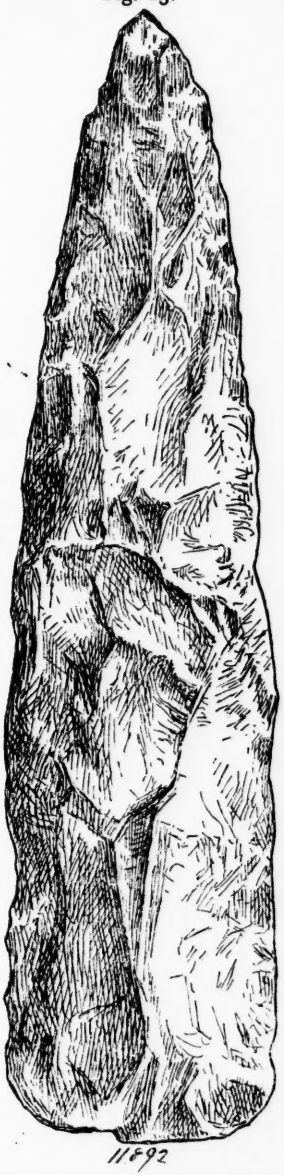
Fig. 22.



Ring of Steatite, Stone-grave Mound, Miss Bowling's farm. Nat. size. 1877.

in the stone graves, though common among surface collections; and but two specimens were found in the three burial mounds explored under my direction, on Miss Bowling's farm. These are made of the same hard green-stone as the specimens obtained at Mr. Overton's place, previously described, and resemble them in size, shape and finish. The smallest is one inch thick, two inches wide and three and one-half long. The other one is of the same thickness, but is one-half of an inch wider and longer. The lower half of these small axes has been ground and polished on both sides, forming a central cutting edge like

Fig. 23.



Chipped Implement, Stone-grave Mound, Miss Bowling's farm. Natural size.

the modern steel axe. The opposite end is left rough, and was probably inserted into a socket of wood or horn, like those from the Swiss lakes, some of which correspond very closely to the specimens from Tennessee, in material, shape and finish. Both of these specimens were found in one grave in the third mound.

In connection with these polished implements of stone, it is of interest to note a fragment of fine-grained sandstone (12344), seven inches long, four wide and two thick, which I found between the graves, in the burial mound here particularly referred to. This fragment is evidently a portion of a sharpening and polishing stone that had been long in use. Its opposite surfaces were concave, and were worn so deep by long use that they had nearly come together, and to this fact the breakage of the stone at this particular point was due. On the sides and in the large concavity of one surface, are small grooves and several deeply cut lines, formed by rubbing implements of different kinds on the stone. As will be inferred, this is a very interesting specimen, illustrating the method of polishing stone implements, and, with the three rings, probably as important as any obtained from this mound.

Fig. 24.

11957

Chipped Implement from Stone-grave Mound, Miss Bowling's farm. Natural size.

Fig. 25.

11870

Chipped Implement from Stone-grave Mound, Miss Bowling's farm. Natural size.

A water-worn stone (12345), six inches long, of oval form, was found in the second mound, and is of interest as furnishing conclusive evidence of the use of natural forms for the various purposes to which they may have been adapted. The stone in question is highly polished on one portion of its surface, and by holding it in the hand in the easiest manner, its adaptation for various rubbing purposes, which would cause the polishing of the particular portion showing use, is readily perceived.

Among the articles found between the graves in the mound, was the half of one of the thin, flat stones with two holes, which are generally classed as personal ornaments.

In mound 2, three discoidal, or "chungke," stones were found. One of these is made of white quartz, highly polished, and is three inches in diameter.

Another, about half an inch greater in diameter, is made of a compact gray sandstone, and shows signs of rough usage on its fractured edge. The third is three inches in diameter, one and one-half thick, and is bi-concave. The material is rather coarse, hard sandstone.

Near the ash bed, which I have already mentioned as having been found under the lower tier of graves, north of the center of the mound, was found a fragment of talcose slate (11961), that probably once formed a portion of a cooking utensil of some kind, or perhaps a large vessel, or possibly a baking stone like those found in the shell-heaps of California. It is a well-worked piece of stone of nearly an equal thickness of about an inch, and on one surface, which is a little convex, slightly smoother than on the other. Near one edge there is a hole three-eighths of an inch in diameter. A careful search was made for other portions of this utensil, but only this was found, and its weathered edges show it to have been a fragment when left near the ancient fireplace.

A small mass of burnt clay (12346), containing the impression of several reeds which had been placed parallel to each other, was also found in the bed of ashes.

Implements made of the bones of animals have been found among the remains of pre-historic races in various parts of the world, and the graves, mounds and shell-heaps of America have furnished many examples of the typical forms. Pointed implements, made from the leg-bones of animals, particularly of the metatarsal bones of various species of deer, are the most common forms, and specimens from the mounds and stone graves of Tennessee are identical in shape and finish with those from the Swiss Lake dwellings.

One of these large implements (11904) here shown (fig. 26), of one-half its diameter, was found in one of the graves in the first mound explored on Miss Bowling's farm.

Other implements for like use were made from the antlers of deer, and two such (11895) were found in grave 15, which, as already mentioned, contained numerous articles. Another similar and pointed tool (11901), made from the leg bone of a large bird, was found in another of the graves in the same mound.

Splinters of bone were also utilized as awls and needles. Two such (11024), six and seven inches in length, and looking like knitting needles, were found in grave 25. These were probably made from pieces cut from the metatarsus of a deer and then polished and pointed. The smaller of these has a slight groove cut around the large end, as if for fastening a thread. The other, which is shown in figure 27, of one-half its length, is smooth and highly polished over its whole surface.

Among the articles found in grave 15 were six small splinters of bone, which have been carefully pointed at one end, and, in those that are perfect, the opposite end is notched as shown in figure 28, representing a perfect specimen of its actual size. These small bones were found close to the skull, and I believe them to have formed part of a hair comb, from this fact and from their close resem-

blance to the teeth of combs found in the graves in Peru, and their still greater resemblance to the wooden teeth in the hair comb once belonging to the famous Modoc, Captain Jack, and now in the Museum. This view was further substantiated by the discovery, afterward, in a grave at Lebanon, of several similar pieces of bone, also by the side of a skull.

Fig. 26.

Implement of Bone, Stone-grave Mound, Miss Bowling's farm. ½.

Fig. 27.

Implement of Bone, Stone-grave Mound, Miss Bowling's farm. ½.

Fig. 28.

Pointed Bone, Stone-grave Mound, Miss Bowling's farm. Natural size.

Fig. 29.

Tooth of a Bear, Stone-grave Mound, Miss Bowling's farm. Natural size.

Several other bones were found in the graves of mound 1, but, with the exception of two wing bones of a large bird (11897), which may have been whistles, there was nothing to indicate that they were intended for special purposes.

Several teeth were also found, among them one of a large rodent, and two canines, probably of a young bear (11917), which were perforated, and, as they were found with a number of beads made of shell, near the neck of the skeleton, it is very likely that they formed part of a necklace. One of these teeth is figured (Fig. 29). Several shells of turtles (*Cistudo*) were found in the graves, and, though they do not show any signs of particular use, they may have been rattles, similar to those known to have been used by some of the Southern tribes, and still common among the Indians.

(*To be Continued.*)

PHYSICS.

THE PHONOGRAPH IN PARIS.

TRANSLATED FROM M. DE FONVIELLE'S "MIRACLES OUTSIDE THE CHURCH," BY MISS IDA HOWGATE.

About a quarter of a century ago, a young man who had just served seven years in a French regiment of cavalry garrisoned in Africa, came to Paris to seek honorable and lucrative employment. His was an earnest spirit, and one that the sun of Algeria had predisposed to bold thoughts.

He arrived in the great city at the time when all were in raptures over the discovery of telegraphy, whose wonders captivated the least sensitive minds.

This young man understood that the wonderful arrangement which permits mechanical force to be diffused at a distance was not the final wonder of electricity, and that it could be used in the conveyance of the visible word itself, as it already was in the conveyance of thought.

The exposition was then conducted by Mr. Paulin, its founder, a man of very great cleverness and industry. Wholly a stranger to the prejudice of the learned societies, he received with great favor the young inventor, who claimed to have solved an apparently insoluble problem, and offered him the use of the columns of his journal.

M. Bourseul described with great clearness the principles which he intended to apply, and he occupied himself with the task of carrying out his invention. He made application to a man already celebrated and who has given more than once in his career, proof of remarkable talents. M. du Moncel, who soon after commenced editing his great work on the applications of electricity, could not avoid honorable notice of the young soldier's claim. But he only mentioned it as one example of the exaggerations to which certain minds, excited by the fever of invention, do not hesitate to yield themselves.

This severe judgment carried the fatal blow to the hopes of M. Bourseul, who renouncing glory and fortune resigned himself to an administrative career, and entered a telegraph office where he still occupies an inferior position.

The invention of M. Bourseul was no other than that of the telephone, which is now in all hands, and which, one day or other, will radically transform telegraphy.

About twenty years after these events, M. du Moncel, as a member of the Academy of Sciences, was written to by an American inventor whose name was not better known than that of M. Bourseul, asking him to present to his colleagues

an apparatus which overthrew all previous knowledge of acoustics, and which, like the telephone, seemed to give a complete contradiction to the theories admitted by the University of Leipsic, and by that of Berlin to be as true as the words of the Gospel.

This stranger was Mr. Edison, and his invention was the phonograph, shown to all Paris during the year of the Exposition at the Capucines, and at the passage of the old opera house. M. du Moncel, who had learned how much it is necessary to mistrust some "*non possumus*" thundered out by the high priests of physics, received with favor the proxies of the stranger and invited them to perform their experiments before him.

When he was convinced of the reality of the phenomena, the learned author of *Applications de l'Electricite* begged the representative of Mr. Edison to follow him to the academy.

Rarely have we been present at so curious a spectacle. The enthusiasm of the majority of persons present was indescribable, greater according to some eye-witnesses than that of the audience of Arago, when that most illustrious of the perpetual secretaries of the Academy of Sciences, placed under the eyes of his fellow members the first proofs obtained by Daguerre, by the aid of photography.

But a few of the colleagues of M. du Moncel, among whom was noticed Dr. Bouilland, did not fear to manifest aloud their anger and incredulity. "It is an indignity," cried they, "to have the Academy exposed to tricks of juggling which a bold ventriloquist has just exhibited before it." "Do not you see that the operator never opens his mouth when he turns the crank of his instrument? etc., etc." Naturally these criticims were spread abroad, and excited some apprehensions among the persons who had only seen the experiments at a distance.

No doubt, however, had crossed my mind until an adventure, which I will relate, as it shows that the use of scientific analysis can, in certain cases, lead to errors not to be feared in a shorter investigation.

The day after I heard the phonograph for the first time, I was able to procure one of the tin leaves which had been used, and I hastened with it to a skillful optician. It seemed to me that in examining the traces left by the stylus the undulations necessary for the production of the articulated voice, could be estimated.

What was my astonishment when we, the optician and myself, discovered that the traces left by the stylus were of the most incredible simplicity. According to the very happy expression of an eminent practitioner, whom I consulted. "I have before my eyes a leaf of sheet-iron on which the marks of a point are left as by a hammer."

The result of this brief inspection was to incline me to the theory of ventriloquism. Cold perspiration covered my forehead. What would I not have given to regain possession of the imprudent articles which, on the faith of the Academy, I had written. I took a carriage and drove at full gallop to the office of the electric pen, in Bourse street, where the phonograph still remained, and which was a place of rendezvous for all scientific Paris.

I did not meet the operator, but a very agreeable American physician, who was employed on Mr. Edison's business.

"I know very well," said I, "that Mr. Pinkar is a ventriloquist, and that this phonograph ——"

"Do you also suspect me of being a ventriloquist?" answered he with a satisfied look. Politeness forbade me to say "yes," so I shrugged my shoulders in an incredulous way. "If so, follow me," he responded, "and the phonograph shall speak for you."

I climbed the staircase without being in the least disturbed by the assertion of my interrogator. But I had to declare myself beaten as soon I heard the first sounds go out from the paper horn, for I had so placed myself that no ventriloquist could have duped me. I took all precautions necessary, for a scientific examination, which in order to be efficacious does not need to be pedantic nor immoderately prolonged. On his side the operator did nothing to avoid any reasonable request without which, however, I would not have extended the examination further.

But the doubts which for an instant had made my conviction waver, had not disappeared from the minds of the academicians, better able than I, however, to proceed to a thorough scientific examination.

It is proper to add, that the noise made about some inventions, which have followed each other during these last months, all of which relate to electricity, has been of a character fitted to excite the jealousy of our Scientific Senate.

If ever these unworthy sentiments can be considered as justifiable, it is when they are produced by a seeming accumulation of success. We are no longer the perpetual secretaries, said one of the members of the bureau some time before these incidents, in referring to M. du Moncel. In fact all the inventors had recourse to the kindness of this affable scholar whose ability is established by so much work, and who, in welcoming the innovators with a courtesy very little academical, seemed to discharge a part of the debt which he had contracted against progress in repulsing, instead of encouraging M. Bourseul.

Toward the end of September, the storm burst forth in a comical way. M. du Moncel modestly asked permission to publish a letter of Mr. Edison's, but on a motion of a member of the committee this request was refused. The pretext was that this important document on the history of electricity had lost its flavor by an anticipated publicity.

Emboldened by the discourtesy of this attack, Dr. Bouilland arose to ask that they forbid M. du Moncel from holding a succession of experiments which have not been previously examined and superintended by a committee; in fact the credit of the society felt itself injured by the exhibition of sophisticated wonders; its reputation becomes conjointly responsible for the good faith of the inventors to whom M. du Moncel extends too lightly his all powerful protection.

The regulations of the Academy of Sciences contain a clause quite as singular as it is generally unknown. Under the pretext that it is not necessary to

infringe upon the opinions of fellowship, which the members of the Academy ought to feel for one another, it is forbidden to appoint any committee to estimate the value of their works or control their assertions. The members of great political assemblies are satisfied with the privilege of being judged with the consent of their colleagues, and, without the consent of this same body, they cannot be attacked.

More careful of their scientific dignity than the members of supreme assemblies, the academicians have conceived an arrangement in virtue of which they cannot be judged by anyone. Fortunately the public does not often need committees or managers to formulate an opinion, and the guilty ones cannot escape the severe condemnation which, sooner or later, the events themselves will pronounce.

In order to respond to this insult, M. du Moncel contrived to bring to the next meeting two of the condemned instruments, the phonograph and the singing condenser.

The talker of this last apparatus had been placed in the parlor, situated at the extremity of the hall—reserved for the sittings of the Academy of Sciences. The door had been carefully closed on the learned operator who had promised to place himself under the superintendence of M. Faye. Scarcely had the two celebrated academicians disappeared when the voice of M. du Moncel was heard coming from some leaves of a paper book placed on the table which is at the foot of the desk. His tone was transmuted in such a manner that the sound seemed produced by a bag-pipe or by a hautboy.

As M. Bouilland was allowed the privilege of taking in his hand the famous sheet of paper, of carrying it to his ear, and of satisfying himself that no ventriloquist had succeeded in creeping in among the leaves, the experiment did not last long. After the instrument had been removed, the meeting resumed its course and essays on the phonograph were read.

By this time not one of the spectators, who had stood motionless close to the wall, nor one of the members of the press had left his place. The ushers, standing gaping in expectation of the scandal about to take place, had forgotten to open the folding doors leading into the hall. Then there took place a scene unprecedented in the comical annals of the Academy of Sciences.

M. du Moncel gravely began to turn the crank, and to pronounce some common place words in the cornet. As the point had been carefully adjusted, the silver paper smoothed in a masterly way, the voice distinctly scanned, and the movement of the crank perfectly regular, the words were pronounced with a clearness entirely irreproachable. Then M. Bouilland, throwing himself on M. du Moncel, pinched his nose, which obliged him to open his mouth in order to breathe and, naturally interrupted the vertiginous movement of the crank. The shrill and ironical voice ceasing to come out from the horn, M. Bouilland imagined that it was because he had forced his colleaugue to open his mouth. "You see it?" cried he with a triumphant air, "you see it, gentlemen? When

I compel M. du Moncel to open his mouth, he can no longer be a ventriloquist, and his phonograph ceases to speak."

Two other members of the Academy desiring to convince a fellow member, in succession turned the crank. M. Bouilland threw himself on them with a fury which excites convulsive laughter in public and even in the assembly. Exasperated by the manner in which his demonstrations were received, M. Bouilland endeavored to show how ventriloquists go to work when they speak with the mouth closed and breath by the nose, but this manner of modulating sounds requires a practice, which the fiery doctor was very far from possessing.

When it was too late, the President saw that this scandal ought not to be prolonged, and he decided to suspend a meeting, which had already lasted too long, as the journal "*Electricite*" remarks in an energetic article which deserves to be repeated.

"M. Bouilland escaping criticism on account of a cerebral affection with which he was attacked, we will not speak of him, whose place is not in the Institute, but in another institution, situated on the borders of the Seine. But let us express our astonishment at seeing that Pres. Pizeau, a philosopher, authorizes scenes such as the dreadful meeting on the 7th of October last, which saddens all who have at heart the scientific dignity of France.

"In order to form for himself an opinion of the phonograph, did M. Pizeau, a philosopher, need such ridiculous experiments as ended the meeting?

"Did he also believe that the phonograph was a work of ventriloquism? Did he also wish to pinch M. du Moncel's nose and so make him open his mouth, in order to satisfy himself that he was not the author of the sounds which seemed to come forth from the cornet?

"If so, let M. Pizeau step down from a chair which he can no longer occupy without peril to French science.

"If otherwise, by what right did the President of the sad meeting on the 7th of October forget that he was the guardian of the dignity of the Institute—that he transgressed his authority in leaving the company, whose initiative he summed up, covered with ridicule by a scandalous scene? '*Presidence oblige.*'"

We must add, that although these scenes grieve us, they do not surprise us; in fact, we can not recall a single important invention, unless under the protection of one of the Academy, which has not been rejected.

Without M. du Moncel the phonograph would be condemned, as have been steamboats, railroads, electric telegraphy, etc., etc.

Although our national self love may be unquestionably wounded by this adventure, we will be consoled if it serves as a lesson for the future—if the public, warned by this scandal, understands the necessity of radically reforming an assembly where so many ignorant persons shade themselves under true illustrious ability.

A little resolution will suffice to regenerate this assembly, so near its downfall. "The Minister of Public Instruction," said a jester, "would only have needed a little strength to cleanse these Augean Stables."

REPORT ON AERIAL NAVIGATION.

The subject of aërial navigation as applicable to Polar explorations, is attracting much attention at present, and we present our readers herewith a report of an experiment made at the instance of Capt. Howgate last fall, by Edson C. Brace, Esq., at Scranton, Pa.

CAPTAIN HENRY W. HOWGATE, U. S. A.:

Sir—I have the honor to report that having been selected by you to witness the inflation of the "King Carnival" balloon, under the management of Prof. Samuel A. King, I proceeded hence yesterday from Washington, arrived here today, and performed the service indicated.

The inflation was accomplished, successfully throughout, in seven hours' time. Gas for the purpose was supplied by what may be termed a "five-foot" generator, of the Lowe pattern or build, which employs the modern method of a steam in conjunction with an air blast. Five "charges" or "turns" were required to fill the balloon. The amount of gas produced by each charge or turn approximated six thousand cubic feet. As will be inferred from the two last statements, the capacity of the balloon is about thirty thousand cubic feet.

I was assured by the foreman of the works at which the inflation took place, that the generator employed could have filled the balloon in less than six hours, and would have done so had not the operation been purposely delayed, which delay was occasioned by a state of weather somewhat unfavorable to the ascension, which Prof. King and I were to have made, but which was prevented by an unfortunate and a partly unavoidable accident. I was further informed by the foreman that the generator, which is the only one in the works, was capable of running off a charge or turn in something less than an hour.

The exact external dimensions of the generator are: height, eleven feet; diameter, five feet. It is cylindrical in shape, and has an inside fire-brick lining of about six or seven inches thickness—thus leaving a clear diameter for generating purposes, of less than four feet. About ten inches of the height are also taken up by the bottom lining.

The gas used for the inflation was made from anthracite coal and crude petroleum oil. The use of the oil rendered necessary the employment of a super-heater, which was connected with the generator. Prof. King objects to the gas produced by this combination for the reason, as he says, that it is too heavy for balloon purposes. He proposes, as I shall show by his own words, to dispense with the use of oil, in an apparatus he has in view for the generation of balloon gas, though he will retain the steam-blast feature of the process mentioned. The gas used in this instance was conducted through the super-heater, thence through the ordinary water-bath coolers, and thence directly to the balloon.

Within two hours after the inflation was completed the weather assumed such a favorable aspect as warranted further preparations for the contemplated ascen-

sion, and Prof. King proceeded, with the aid of a number of men, to tow the balloon from the gas-works yard to a public square of the city, whence the ascension was to be made. He had progressed but a short distance, however, when the balloon was borne, by a sharp breeze, against a "stand-pipe" in a reservoir, and so damaged that a collapse almost immediately followed.

The experiment demonstrated to my satisfaction the feasibility of filling a balloon of even two or three times the capacity of the "King Carnival" within a reasonable time, with a generator as small as the one described; the only possibility of failure existing in, or relating to, the gas-holding qualities of the material of which the vessel is made.

Prof. King made to me the following statement, which casts some additional light upon his views, as I understand you have ascertained them, concerning his contemplated portable balloon-gas-generating-apparatus: "As far as the Lowe process is concerned, I propose to use the same process. It is really the 'tessie demotay' process, but is used in connection with the old process. The Lowe has a super-heater—that is to say, he produces hydrogen gas made from steam passing through the coals, and gas made from crude-petroleum oil, which is allowed to percolate through the coals at the same time that the hydrogen is making; and the two gases pass through the super-heater, where, by means of heat obtained from the generator when blowing air through it, the two gases are chemically combined and form a 'permanent' gas—carbureted hydrogen. That is the only service the super-heater performs—it combines these two gases into one. The oil-gas is too heavy for balloon purposes, and consequently we want to leave that out, and leaving that out we consequently have no use for the super-heater. With that exception I propose to use that process. We pass steam through the incandescent coal. It comes from the generator an impure hydrogen gas, containing carbonic acid and carbonic oxide. The carbonic acid is then removed by a suitable and familiar process, and the carbonic oxide will remain with the gas. We get, I think, forty-six pounds buoyancy to every thousand feet of gas. It will want a small engine—four-horse power is sufficient—and a small blower. The cylinder of the generator can be made in sections, of cast iron, if no fire-brick are used, and of wrought iron if fire-brick are used. The sections can be luted with clay and then bolted together. By this portable apparatus we can make the generator larger or smaller than the one we used to-day, at our preference or choice. It could be made smaller, I think, and yet answer every purpose in inflating balloons of ordinary size. I shall have such a generator made for my own use, and I have no doubt of its practicability, based on my experience. These brief notes I am giving you are wholly the result of my experiments and judgment in those matters."

Very respectfully, your obedient servant,

EDSON C. BRACE.

GEOGRAPHICAL NOTES.

NORDENSKJOLD'S EXPEDITION.

A letter has been received, via St. Petersburg, from Prof. Nordenskjold, under date of September 25, 1878, in which he announces that all the men connected with the expedition were well. This intelligence will set at rest the great anxiety about Prof. Nordenskjold's fate. There is little doubt that he will be heard from *via* Yokohama as soon after the ice breaks up as it is practicable for him to reach that port.

THE DUTCH ARCTIC EXPEDITION OF 1879.

It has been decided to send the little exploring vessel, the "William Bareutz," on another trip to the Arctic Seas this summer, sailing early in June. The scientific staff will resume the sounding and dredging operations of last summer, and try to reach Bareutz Icehaven, and build a suitable monument on the spot of the famous winter quarters of Bareutz. If time and circumstances permit, they will navigate the Kara Sea. Capt. A. De Bruyne and the Jonkheer, H. M. Speelman are the only two members of the last year's expedition who will again serve —the former as commander and the latter in charge of the magnetical observations. Mr. W. G. A. Grant will again accompany the party as photographer. Lieut. Beynen will be replaced by two officers, Mr. Broekhurjen, Lieutenant 1st class, and Mr. Kalmeyer, Lieutenant 2d class. Mr. L. De Jeude, student at Utrecht, will go as Zoölogist. The crew will number nine men, instead of eight as last year.

AWARD OF MEDALS.

At the meeting of the English Royal Geographical Society, Monday, April 28th, it was announced that the gold medals of the Society had been that day awarded to Col. Nicholas Prejevalsky, for the great additions he had made to the world's knowledge of Central and Eastern High Asia, by his successive expeditions into the unexplored parts of the great plateau of Mongolia and the lofty deserts of Western Thibet, and for the admirable way in which he has described the regions traversed by him in the published narratives of his journeys; and to Capt. W. J. Gill, R. E., for excellent geographical work performed during two journeys of exploration, voluntarily undertaken, along the northern frontier of

Persia, in 1873, and over previously untraveled ground in China and Thibet, in 1877; also for the elaborate memoir and route maps contributed to the forthcoming volume of the Society's Journal.

A new African expedition is being organized at Lisbon, under the direction of Capt. Paiva d'Andrada. Its object is the exploration of the Zambezi and the foundation of commercial and agricultural colonies in the territories of Fete and Zoumbo.

The second session of the Congress of Commercial Geography, inaugurated at Paris last year, will be held at Brussels in September, under the presidency of M. Bamps.

No. 4 of *Petermann's Mittheilungen*, now edited by Drs. Behm and Linderman, contains, among other valuable papers, an interesting account of Capt. Howgate's "Florence" expedition of 1877-8, including a brief summary of the scientific results attained.

THE CENTRAL AMERICAN CANAL.

The representatives of the various countries interested in the establishment of water communication between the Pacific and Atlantic oceans, through Central America, met in Paris May 15th, to discuss the merits of the various routes that have been surveyed through the America isthmus. The delegate from the United States is Admiral D. Ammen, officially at the head of the Bureau of Navigation in the Navy Department, and who has been identified with the subject for years.

Among the different governments which have made extensive surveys in Central America, the United States occupies the first place. The latter has sent during the last decade various exploring expeditions to examine the routes by which a practical result could be expected. Since 1872 the following detail surveys have been made, viz.:

In 1872, the survey of the Isthmus of Tehuantepec, Capt. Shufeldt, United States Navy, commanding.

In 1873, the survey of the Isthmus of Darien, with surveys in the Atrato Valley and Napipi River, Commander Selfridge commanding.

In 1874, the Nacaragua survey, and in 1875, the survey of the Isthmus of Panama, with location of Canal, etc., between Panama and Aspinwall, Commander Edward P. Lull commanding.

The important labors of these different expeditions were performed with the most scrupulous care, and the high character of the gentlemen who composed them is a guarantee for the reliability of their reports. Besides the United States,

British and French explorations have been made in different parts of Central America with the same object. It was, however, not until M. de Lesseps, the originator of the Suez Canal, had identified himself with the scheme that practical steps were taken for the accomplishment of the canal. As a consequence of his endeavors, in which he was ably assisted by Lieutenant Commander De Wyse, of the French Navy, an international congress is now assembled in Paris, France, to examine the results of the different surveys and to decide, after a careful consideration, which route is most favorable for adoption.

The engineers who have examined the Nicaragua Isthmus have seen that no serious obstacles exist in the way of the enterprise, and, although their observations were confined to the line of the canal, they nevertheless gained a clear idea of the elements of wealth in which that region abounds.

We will give a brief description of the route across the isthmus and the estimate of cost necessary for the accomplishment of the work. The Central American States in general are very mountainous, and the various mountain chains and their branches intersect each other in every direction. Nicaragua alone is an exception in this respect. Four of its provinces—viz: Rivas, Granada, Leon and Chinandega, the principal ones as regards the development of their agriculture. commerce and manufactures—are level, especially the first named, which comprises the isthmus proper, and which has always been considered as the most suitable locality for the canal. The materials which would be required for the construction of the work are found in inexhaustible quantities in the provinces referred to. Lime and stone quarries abound along the line of the canal.

Nicaragua possesses among its various lakes two which are especially worthy of attention—viz., Lake Managua and Lake Nicaragua. The former, which is smaller than the latter and has twenty-two feet more altitude, flows into it through the Tipitapa River, and both together, with that natural canal, occupy an extent of nearly two hundred miles in length. The shortest distance between the great lake and the Pacific Ocean is not greater than ten miles, and, notwithstanding the curves of the line now proposed, which terminates at the port of Brito, the length of said line does not exceed sixteen miles. The great body of water which the great Nicaragua Lake pours into the Atlantic through the San Juan River, its small elevation above the average level of the two oceans (106 feet), the great relative depth of its waters, and other inestimable conditions, make that lake the true harbor of the canal, where all the squadrons of the world would at all times be able to find shelter.

It is very noteworthy that throughout the route proposed for the construction of the canal in Nicaragua, the maximum depth of the cut is so small that tunneling is entirely unnecessary; the insignificant elevation of the great lake above the level of the oceans reduces extremely the number of locks, an exorbitant number of which impedes general traffic.

The entire length of the proposed Nicaragua Canal, from ocean to ocean, is 181 miles, with a width of 150 feet and a depth of 26 feet. It is proposed to

make Lake Nicaragua the summit level of the canal, and to connect the lake with the Pacific by canal and with the Caribbean Sea by a combination of canal and slack-water navigation. The first section of the proposed canal from the lake to the Pacific leaves the lake at the mouth of the Rio del Medio, and extends for a distance of 7.58 miles, with an average depth of cutting of 54 feet. The second section extends from the end of the first to the Pacific Ocean, at Brito, a distance of 8.75 miles, making the total distance from lake to sea 16.33 miles. There would be ten descending locks in this section, each having a lift of 10.31 feet, besides a tide lock at the terminus of the canal, to admit ships at any stage of the tide. From the mouth of the Rio del Medio to Fort San Carlos, at the head of the San Juan River, the distance is 56 statute miles. Twenty-six feet of water can he carried to within 1,200 feet of the mouth of the Del Medio. Some underwater blasting would have to be done to deepen the channel to the end of the canal. On the east side a channel would have to be deepened by dredging for a distance of about seven miles, to a mean depth of about eight feet, the bottom being a firm mud, without rock. As the water is always perfectly smooth on this side of the lake, a dredge could work every day of the year. The eastern division extends from Fort San Carlos, at the lake, to the harbor of San Juan del Norte, or Greytown. It is 108.43 miles in length, of which 63.02 miles are in slack-water navigation, and 45.41 miles of inland canal. The San Juan is proposed to be made navigable by four dams, to be located severally at Castillo, Balas, Machuca Rapids, and a mile below the confluence of the river San Carlos, with short canals along these dams, with a lock of 10.28 feet lift in each. Just below the mouth of the San Carlos the canal would be taken from the river and located along the valley of the river to the head of the Juanillo branch of the San Juan, thence by an almost straight line toward Greytown, at a distance of 41.90 miles from the point of leaving the San Juan at the mouth of the San Carlos. Out of this latter distance 36 miles would be in excavations and embankments combined, and 6 miles across low hills. Ten locks, 400 feet long and 70 feet wide, with walls 41 feet high, are proposed in this division, the first three located in the short canals around the dams, and the remaining seven in the lower part.

An artificial harbor is proposed to be made at Brito by means of a breakwater and dredging. Suez as well as Port Said are artificial harbors. The dredging would extend over an area of sixty-seven acres, which is thought to be sufficient to meet the traffic of the canal, particularly if the proximity of the lake is taken into consideration, where any number of vessels can find ample and safe anchorage.

At the Atlantic side the harbor of San Juan del Norte, or Greytown, would be made available and improved, the sand-bar removed, and the discharge of sand, brought down by the San Juan River, diverged by turning the lower waters of the San Juan into its Colorado branch. Careful and minute estimates for the accomplishment of this canal and accessories have been made by Civil Engineer A. G. Menocal, United States Navy. They are as follows:

For Western division, from mouth of Rio del Medio to the Pacific Ocean	$21,680,777
For Middle division, comprising lake navigation, from mouth of Del Medio to Fort San Carlos	715,658
For Eastern division, from San Carlos to Greytown; slack-water navigation, 63.02 miles; inland canal, 45.41 miles; or 108.43 miles.	25,020 914
For harbor of Brito	2,333,739
For harbor of Greytown	2,822,630
Total	$52,577,718
Add twenty-five per cent for contingencies	13,144,429
Giving a grand total of	$65,722,147

The construction of this work requiring neither tunneling nor the formation of a deposit of water, the length of the purely artificial canal being so limited, and considering the small number of locks, the costs of improving ports, and of accessory labor of less importance required, the estimate of $65,000,000 can be considered a close approximation to the truth. This outlay, which is by no means exorbitant for an enterprise of such transcendent importance, could be diminished to the amount of several millions by a more detailed location of the proposed line, by the value of lands which Nicaragua is disposed to grant in favor of the canal and by the sums with which she would now aid the immediate improvement of navigation in the San Juan River. Even suppose the amount required to be double of the above estimate, the commerce of the world would insure a remunerative interest. The Suez Canal, the cost of which cannot be placed at less than $400,000,000, whose success was so long a matter of dispute, and whose importance will undoubtedly always be inferior to that of the American canal, is now an enterprise whose future prosperity is more than assured.

Resolutions adopted by the St. Louis Medical Society of Missouri, April 26, 1879:

WHEREAS, The St. Louis Medical Society of Missouri, in common with other associations of liberal and scientific men, is deeply interested in the advances made during the last fifty years toward an exploration of the Polar regions and the attainment of the Pole itself, and are fully alive to the value of the additions to our knowledge already realized by successive expeditions up to the present time; and,

WHEREAS, Observations directly at the Pole, or in its vicinity, especially if prolonged and made with a systematic regularity hitherto unrealized, cannot fail to be of great importance to various departments of science and to the arts of life which are based upon scientific determination; be it, therefore,

Resolved, That this Society regards the proposed "Colonization Plan" of approach to the North Pole as the only one by which success can be reasonably anticipated, as well as the only one which can afford opportunities for the prolonged and systematic observation needed by science, whose results alone would far out-

weigh in value all pecuniary disbursement necessary for giving the system a full and thorough trial.

Resolved, That this Society hereby requests, and respectfully urges, the Senators and Representatives of the State of Missouri now in Congress assembled to support and vote for the proposed plan of Capt. H. W. Howgate for reaching the Pole, and for all measures designed to aid in carrying it into effect.

Resolved, That the Corresponding Secretary of this Society be instructed to forward a copy of these resolutions to each of our Senators and Representatives in Congress, as soon as practicable.

Resolution passed by the Merchant' Exchange of St Louis, Feb. 13, 1879:

WHEREAS, There is now pending in Congress a bill appropriating the sum of fifty thousand dollars to be expended under the direction of the President for the purpose of sending out one or more expeditions toward the North Pole; and,

WHEREAS, We believe that the plan of "Polar Colonization" advocated by Capt. H. W. Howgate, U. S. A., is the most feasible of any heretofore projected for the exploration of the Arctic regions, and for the discovery of the North Pole; and,

WHEREAS, Other nations are prosecuting, or about to prosecute, the plan proposed by an American; therefore be it

Resolved, That our representatives in Congress be requested to urge the passage of this bill, as we believe that it will reflect credit not only upon the men personally engaged in it, but upon the whole nation.

Resolution passed by the St. Louis Academy of Sciences, April 21, 1879:

WHEREAS, It is in harmony with the objects for the promotion of which this Academy was founded, to encourage enterprises calculated to increase our knowledge of the physics of the globe; therefore,

Resolved, That this Academy heartily approves Capt Howgate's plan of Polar colonization, and urges upon Congress to pass the bill providing for the expenses of the project.

GEOLOGY AND PALÆONTOLOGY.

THE NEW SINK-HOLE IN MEADE CO., KANSAS.

BY PROF. B. F. MUDGE, MANHATTAN, KANSAS.

Exaggerated accounts of this phenomenon induced the writer to make a visit to the spot and examine this singular freak of nature.

During the month of March last a sink-hole was found, where before was a smooth, grass grown prairie, crossed by a wagon road. The spot is 40 miles south of Dodge, in an unsettled portion of the state, with a very few ranches for stock-raising in the adjoining country. The wagon road is little frequented; and early in the month, those passing saw nothing new; but about the 18th the road was gone and a deep cavity in its place. As our party found it, May 5th, it had the appearance of a gigantic well, sixty feet deep and six hundred and ten feet in circumference, being nearly circular. More exaggerated dimensions have been published, but we made careful measurements. The walls were perpendicular, or nearly so; we had difficulty in finding a spot where we could go down to to the waters edge. The material of the soil, as far as we could see, seventeen feet deep, consisted of a firm clay-shale of reddish tinge. At the time of our visit there had been no rain, and the whole appearance was as fresh as if the subsidence had just taken place. All around the cavity were circular cracks, parallel to the rim, from five to fifteen feet or more deep and from one to ten inches wide. These had opened at the time of the catastrophe, and at first sight appear ready to cave in, but one of our party who visited the spot a month earlier, stated that these had not changed during that time. The arrangement of these cracks is different from those described by Lyell, as seen in sink-holes caused by earthquakes. Those radiate from the center, but these go round as imperfect circles. The most distant cracks were 126 feet from the rim, being most distant on the northwest side and less on the south side. We found the depth of the water at a few feet from the shore to be from 15 to 27 feet, at the center it was 42 feet. As the surface of the water was 17 feet below the surface of the ground, the total depth of the cavity was about 60 feet. The water is a strong brine, an analysis of which, by Prof. Geo. E. Patrick, of the State University at Lawrence, is hereto appended. It will be seen that it is about two-thirds saturation, which is much stronger than other salt springs in the State. This will give, deducting for impurities, one bushel of salt for forty-three gallons of the water. About seven per cent. only of impurities are present, but the amount of chloride of lime is objectionable.

I would take this occasion to express my thanks to Prof. Patrick for his kindness in making this analysis, as well as for other similar favors.

The position of the sink is on the side of a small, rounded hill, sloping gently to the east, and about 40 feet above the valley of Crooked creek, a tributary of the Cimarron river. The road ran just inside of the edge of what is now the cavity, and a buffalo trail ran directly across its center. The tops of the higher hills in the neighborhood are capped by a sandy concretionary limestone belonging to the Benton group of the cretaceous age.

This sink-hole is the more interesting as no instance of the kind has been known in this State. I examined the country in the vicinity, and could find no holes or depressions which indicated that any similar phenomena had occurred. Hunters and herders had seen nothing like it But nearly similar instances have been known in Kentucky.

My explanation of the phenomena under consideration is this: The Dakota sandstone crops out in Clark county, twenty miles distant, and dips at a small angle toward this spot, and undoubtedly underlies the whole of Meade county. This sandstone is quite soft in some of its strata, and covered by harder beds. The softer portions are liable to be washed out by subterranean waters, and thus form caverns which are roofed by the hard layers. The cavern in this case became enlarged until the roof was unable to sustain the over-lying prairie soil and shale, sixty feet in thickness, and the result is what we now behold. As what was the grass-grown prairie is now the bottom of the cavity, the height of the cavern must have been at least sixty feet, and its floor at least twice that distance (120 feet) below the traveled road. If it is still spread out in smaller chambers, other depressions like the present may occur.

The following is an analysis of the salt water from the Meade county sink-hole, by Prof. Geo E. Patrick, of the State University, Lawrence, Kansas:

Specific Gravity, 10.719.	Grains per U. S. Gallon.
Sodum Chloride (Common Salt)	9 886.7
Calcium Chloride (Chloride of Lime)	365.9
Magnesium Chloride,	259.4
Calcium Sulphate,	207.1
Total	10,719.1

There is an entire absence of iron, potassium and lithium; gases practically none, and organic matter none.

PROF. MARSH ON THE FOSSIL POLYDACTYLE ANCESTORS OF THE HORSE; AND RECENT EXAMPLES.

PROF. E. L. BERTHOUD, GOLDEN, COLORADO.

Prof. O. C. Marsh, in the June number of the *Journal of Science*, has given to the scientific world an article of exceeding interest on polydactyle horses, both recent and extinct.

The learned professor, some years since, gave a trite, interesting and very suggestive article on the development of our present horse from the most remote ancestry of many-toed ungulates, which his fossil discoveries in Utah, Wyoming, Colorado and Nebraska enabled him to do, and which he has turned to such good account as an irrefutable argument in proof of evolution. Recent discoveries have added one more link to his deductive theory, and in the article above referred to and just published he gives us an almost complete sequence.

To-day the scale of Prof. Marsh's equine development is thus succinctly given:

"The original ancestor of the horse, not yet discovered, undoubtedly had five toes (or hoofs) on each foot."

The next in the ascending scale, very recently discovered at the base of the Eocene, the oldest Tertiary formation, was an animal as large as a fox. It had on each fore foot four toes and the rudiments of a fifth, and three toes on its hind feet. This quadruped is called "Eohippus," literally the "dawn of the horse."

The next in the scale is called by him "Orohippus," also in the Eocene; had four toes on each fore foot, three on each hind foot; was no larger than Eohippus.

There comes with it, but higher in the Eocene, another allied genus, with the same number of toes, but with different dentition. Thishe called "Epihippus," a slight modification that points already to a still further change in the ascending scale.

Following the Eocene Tertiary comes the Miocene Tertiary, which is sharply and well defined in geological age from the Eocene. In this division of the Tertiary, we conceive, took place the last and most serious modifications, that have resulted in causing the present conditions of climate temperature, the seasons as now occurring, the total annihilation of Arctic vegetation and its accompanying animal creation, which undoubtedly then existed in high latitudes. Can we then but admire the sagacity of Prof. Marsh's deductions, when from such ancient fossils as a few petrified bones, a few fossil teeth, he produces and reconstructs another link in his equine sequence. From the lower Miocene comes now the "Mesohippus," as large as a sheep, with three toes on each hind foot, three on each fore foot, with a fourth or rudimentary one on each side. We rise still higher in the Miocene, and he finds a still further modification, the "Miohippus," where the fourth, rudimentary toe of the Mesohippus is reduced to a mere short remnant of a splint bone.

The Miocene is passed, and we come now to the Pliocene, the most recent of the Tertiary formations. Here he finds the three toed horse, "Protohippus," literally the "first horse" is the meaning of that term—an animal, he tells us, as large as a donkey. Thank heaven, we have no mules of that kind. A merciful Providence has kindly closed out that race of animals, for our modern mule, if gifted with such an array of hoofs, would render this globe almost uninhabitable, and profanity would be inadequate to do justice to such a periphery of kicks!

Following the Protohippus, we now find another, still more perfected and selected animal, the "Pliohippus," or the "horse of the Pliocene," with only one hoof or toe on each foot, and with a true splint bone on each side of the single toe. Succeeding the Pliohippus appears a true fossil horse, as large as our existing horse, and we have the series completed.

Thus far in the series, from the less perfect to the present form, the learned, sagacious Professor has shown by the marvelous precision of his inductive reasoning that an undisputed evolution, reaching, we might say, far into the "night of ages," but only on the threshhold of geological chronology, has undoubtedly taken place. Yet may we not despair that even the age of the Eocene may be numbered and its duration counted from to-day in a close approximation.

Prof. Marsh, after his exhaustive examination of the probable (we might almost say the certain) descent of our present horse from the far-back ancestry of the Eocene five-toed ungulate, has given us a striking example of what seems to be in our modern horse a reversal to the primeval one-toed horse of the Pliocene. This is an example that the author of this sketch has himself seen, namely, a horse with a rudimentary, well formed toe on the inner side of each leg, ending in a small hoof, in no manner interfering with the prompt action or the rapid gait of the animal gifted with such apparently superfluous appendages The importance of this observation which if further proved to be not an isolated example (of which Prof. Marsh says he has two or more examples well authenticated), is clear, and we have an almost absolute proof that the learned professor's filiation of descent of our present equus is at least pretty well demonstrated, and the Pliocene "Hipparion," or Protohippus, is the remote and immediate ancestor of the Pliohippus, the one-toed horse of the Pliocene.

It is needless here to go over the ground, so often discussed, of the imperfection of our geological record and its accompanying fossils. Suffice it to say that every day we discover new and unknown species. The gaps that thirty or forty years ago left such uncertainty in the generic succession of species, both vertebrate and invertebrate, in the different geological ages, are being rapidly bridged, and we do not doubt but that ere long other intermediate forms must be found, showing still more clearly the slow but sure changes that vast periods of time effected in the progressive development from the Eohippus to the Pliocene horse.

ASTRONOMY.

MARS INHABITED, LIKE OUR OWN EARTH.

CAMILLE FLAMMARION.

[*Continued.*]

But to what cause are the clouds of Mars due? Evidently, like ours, to the evaporation of water. And the ice? Evidently, also, to the congelation of water. But is it the *same kind* of *water* as we have here? Some years ago this problem remained unsolved. To-day it is possible to answer it.

The marvelous processes of spectroscopy have been applied to the study of the planets, principally by the learned English physicist, Huygens. Now the planets reflect the light that they receive from the sun; when we examine the spectrum of their light, then, we see the solar spectrum as if reflected from a mirror. By directing the spectroscope toward Mars, it was ascertained at first that, in the luminous rays given forth by this planet, there was a perfect identity with those which emanate from the central star of our system. But, by using more accurate methods, it has been found, during the later appositions of the planet, that the spectrum of Mars is crossed in the orange zone by a group of black bands *coinciding with the lines* which appear in the solar spectrum *at sunset*. What atmospheric substance is it that produces these lines? By examining their position it is ascertained that they are due to the presence of neither oxygen, nitrogen, nor carbonic acid, but to watery vapor, which is distributed through the atmosphere of Mars in as large a quantity as it is in our own. The green spots of this globe are indeed seas—expanses of water analogous to those of the earth. The clouds are indeed vesicles of water solidified by cold. And further, this water being, as shown by the spectroscope, of the same chemical composition as ours, we know, moreover, that oxygen and hydrogen are there also

These important proofs permit us to form an idea of the meteorology of Mars, and to see therein a very similar reproduction of that of the globe we inhabit. On Mars as on the earth, in fact, the sun is the supreme agent of movement and of life, and its action determines there results analogous to those that exist here. Heat vaporizes the water of the seas and carries it aloft into the atmosphere; this watery vapor assumes a visible form through the same process that gives rise to our clouds—that is, through differences of temperature and saturation. Winds arise through these same differences of temperature. We are able to follow the clouds as they are borne along by aerial currents over the seas and continents; and many an observation has, so to speak, photographed these meteoric varia-

tions. If we do not literally see the rain fall, we at least take it for granted, since the clouds dissolve and are again renewed. If we do not see the snow fall, yet we assume that also, since, as with us, the winter solstice is occompanied by hoar frosts. Thus, there as here, there is an atmospheric circulation, and the drop of water of which the sun robs the sea, returns to it again by falling from the cloud which harbored it. And more, although we should firmly guard ourselves against creating imaginary worlds fashioned in the image of our own, yet the one under consideration presents us, as if in a mirror, with such an organic similitude, that it is difficult not to go a little further in our description.

In fact, the existence of continents and seas shows us that this planet has been, like ours, the seat of interior geologic movements which have given rise to upheavals and depressions of the land. There have also been earthquakes and eruptions that have modified the primary uniformity of the globe's crust. Consequently, there are mountains and valleys, plateaus and basins, steep ravines and cliffs. How do the rain-waters return to the sea? By springs, brooks, creeks and rivers. So it is not difficult to see on Mars scenes analogous to those that form our terrestrial landscapes; purling brooks flowing over their beds of sun-gilded pebbles; rivers crossing plains, and falling in cataracts to the bottoms of valleys, or slowly descending to the sea over their beds of fine sand.

The sea shores there, as here, receive the tribute of aquatic canals, and the sea is now calm and mirror-like, and now lashed by tempests; it is also agitated by a periodic movement of flux and reflux, since the planet has two moons to produce these tides.

So, then, there is in space, at some millions of miles from here, an earth almost like our own, where all the elements of life are collected, as they are about us—water, air, heat, light, winds, clouds, rain, water-courses, and mountains. To complete the resemblance, we will also remark that the seasons there have almost the same intensity as ours, the axis of the planet being inclined 27° (ours is inclined 23°). The length of the day is 40 minutes greater than ours; it is exactly 24 hours, 39 minutes and 35 seconds.

Before all this, is it possible to stop for a single instant at the statement of these elements and these movements without considering the effects that they have produced, and that they are to produce? The physico-chemical conditions that have given birth to the first vegetation that appeared on the surface of our globe being realized up there as they are here, how could they have been in presence without acting in some way or another? Under what scientific pretext can we imagine an arbitrary prevention of the realization of these results? The fact is it would require an incomprehensible interdiction, a supreme veto, something like a permanent annihilation, to prevent the rays of the sun, the air, the water, and the earth (those four elements divined by the ancients) from entering at every moment into an organic evolution. While the least drop of water teems here with myriads of animalcules, while the ocean is the abode of thousands of animal and vegetable species, what effort would not our reason require to imagine that in

the midst of like vital conditions, the world under consideration has been able to remain eternally in the state of a vast and useless desert?

Such is the chemical and physical knowledge that we have concerning this planet; we may complete it by an examination of its special mechanical conditions, such as its weight, its volume, its density, and the force of gravity at its surface.

The diameter of Mars is to that of the earth as 5 to 8; that is to say, it is almost half smaller. It is 4,400 miles in mean diameter, while the mean diameter of the earth is 7.912 miles. The surface of Mars is consequently two and a half times less in extent than that of our world. The total weight of the planet, or its mass, is only one-tenth of the weight of our globe.

The mean density of the materials which compose this planet is less than that of the constituent matter of the earth, being 71 per cent. As a result of this density and of the dimensions of Mars, the weight of a body at its surface is extremely light. So the force of gravity at the surface of the earth being represented by 100, it would be only 38 at the surface of Mars, which, indeed, is less than it is on any other planet of our system. The consequence is that a terrestrial pound avoirdupois, transported thither, would weigh only about 6 ounces. A man weighing 150 pounds, transported to Mars, would not weigh 60 pounds. He would be no more fatigued from running 5 miles, than he would be from running 2 miles on the earth. The muscular effort brought into play by boys during the game of "leap frog," would, on the surface of Mars, not only permit them to jump over the backs of their companions, but even over the roofs of houses and tops of trees. A study of modern statistics demonstrates scientifically that man is the product of the terrestrial planet, so far as organization is concerned (his soul being left out of consideration, a matter of which we will not speak here). His weight, his stature, the density of his tissues, the weight and size of his skeleton, length of life, periods of work and sleep, the quantity of air he breathes, and the food he assimilates, all organic functions, even those that seem most arbitrary, and even to maximum periods of birth, marriages, and deaths—in a word, the human machine all entire is organized by the planet. The capacity of our lungs and the form of our chest, the nature of our food and the length of our digestive tube, the gait and the form of the legs, the sight and the construction of the eye, the thought and the development of the brain, etc., etc., all the details of our organism, all the functions of our being, are in intimate, absolute, permanent correlation with the world in the midst of which we live. The anatomical construction of our body is the same as that of the animals which precede us in the scale of creation. We are made as we are, because the mammiferous quadrupeds are made as they are; and so all species of animals follow one another like the rings of the same chain; and, in ascending from ring to ring, we find the first rudimentary organisms which are still more *visibly* yet none the less the product of the forces which have given them birth. This truth recalled, we see that the terrestrial human form has nothing arbitrary, that it is the result of the state of the planet, and that, consequently, it

differs on every planet according to the organic conditions of each one, which are so uniike those of another.

In tracing the formation of the zoölogical series, we may conjecture that the succession of species will have been strongly influenced, on Mars, by gravity. While that here the great majority of the animal races has been obliged to remain close to the surface of the soil through terrestrial attraction, and that a very small number have received the privilege of wing and flight, it is very probable that, owing to a very special disposition of things, the Martial zoölogic series has been developed by preference through a succession of winged species. In this case, the superior animal races are there furnished with wings. On our sublunary sphere, the vulture and the condor are the kings of the aerial world; up there the great vertebrate races and the human race itself (which is the result and last expression of it) have the very enviable privilege of enjoying aerial locomotion. The fact is so much the more probable, inasmuch as to the less gravity is added the existence of an atmosphere analogous to our own and perhaps more dense. So it is almost certain that the *inhabitants of Mars are of a different form from us, and fly in its atmosphere.*

Finally, let us add that this interesting planet proceeds in the heavens accompanied by two satellites. This recent discovery is one of the most curious in contemporaneous astronomy. It was made in 1877 by the aid of the great telescope at the Washington Observatory, and the best in the world. The American astronomer, Prof. Asaph Hall, undertook an attentive examination of the surroundings of Mars, from the beginning of the month of August, 1877, and a diligent observation of this neighboring planet during the whole of the favorable period of its greatest proximity to the earth. In masking the disk of his instrument to avoid the influence of light, he had the pleasure of discovering, on the 11th and 17th, two little luminous points which were accompanying the planet in its celestial march, and of observing them long enough to determine their orbits. This news was received like a thunder-clap by European astronomers, half of whom remained incredulous until they were fully informed. But the discovery was soon verified absolutely.

These two satellites are minute worlds—the smallest that we know. The first appears to be about 7½ miles in diameter, and the second 6 only. They are, indeed, only the breadth of Paris! And yet they are perceived at a distance of 45.000,000 miles. In size they are not even terrestrial continents, nor even empires, nor even provinces, nor even departments. Alexander, Cæsar, and Charlemagne would have cared little to receive the scepter from them. Gulliver would have played with them, as a juggler with his balls; Micromegas would have forgotten them in his fob.

However, who knows? The vanity of men being generally in direct ratio to their mediocrity, it is very probable that the reasoning microscopic mites that swarm on their surface also take pride in possessing armies which tear each other in pieces for the possession of a grain of sand.

XUM

Such is the general physiology of this neighboring planet. The atmosphere which surrounds it, the waters which irrigate it, the sun's rays which warm and light it, the winds which sweep across it from pole to pole, and the seasons which transform it, are so many elements for creating an order of life analogous to that with which our planet is provided. The low force of gravity at its surface must have particularly modified this order of life by adapting it to its special condition. So hereafter the globe of Mars ought no more to present itself to us as a block of stone turning in space in the sling of solar attraction, as a sterile, inert, and inanimate mass; but we ought to see in it a living world, ornamented with landscapes, where the noise of the wind is heard and the water reflects the light of heaven, a world peopled with numberless beings hovering about in its atmosphere—a new world that no Columbus will reach, but upon which, however, a human race now dwells, works, thinks, and, no doubt, meditates, as we do, on the grand and mysterious problems of nature.

THE APPROACHING CONJUNCTION OF MARS AND SATURN.

PROF. C. W. PRITCHETT, MORRISON OBSERVATORY.

As you desire short and familiar articles on astronomical subjects, it may not be amiss to call the attention of your readers to the very interesting conjunction of the planets, Mars and Saturn, which occurs on the 30th of the present month, (June).

True, neither of these planets will be visible above our horizon, at that date, until about twenty-three minutes past midnight; yet as so favorable a conjunction rarely occurs, (the last having occurred April 18, 1817) some may be found to take sufficient interest to watch, once in a lifetime, these ancient members of our solar system, as they approach and pass each other in their orbital revolutions.

An observer who will take the pains to examine the eastern heavens, June, 30th, (civil time,) at any hour of the morning between 1 o'clock and the dawn of day, will see these two planets very close together. Mars will appear *west* of Saturn about thirteen minutes of arc, or less than half the diameter of the moon. He will also appear *south* of Saturn, about four minutes of arc. The yellow-red of Mars will appear in strong contrast with the dull white of Saturn. If the observer is furnished with an instrument of sufficient power, he will find the diameter of Saturn, *then*, to be 17.$\frac{1}{2}$ seconds, while that of Mars will be 8.8 seconds.

Now, remembering that both planets are moving northward and eastward, and Mars about fourteen times faster than Saturn, let us suppose that our observer could move westward round the earth in twenty-four hours, so as to keep the two planets all the time in full view, the sun being two hours or more below his horizon during the entire circuit. On reaching the Pacific Coast, he would find the planets perceptibly nearer each other, than when he left the Eastern States, the distance being now reduced to eight or ten minutes of arc. Moving

on through the islands of the Pacific, he would find them approaching nearer and nearer still, till he reached Australia or India. At the observatories at Melbourne and Sydney, N. S. W., the two planets could be seen at their nearest approach; and the great circle arc joining their centers, would *then be* only 1′ 13″ in length. Our traveler continuing his journey homeward through India, Europe and across the Atlantic, and having the planets still in view, would find Mars passing northward and eastward of Saturn, so that on reaching the eastern coast of America, he would find the position of the two planets nearly the reverse of their positions twenty-four hours before, while in the mean time he would have seen all the successive phases of approach to be had in different longitudes. The time of nearest opproach of centers will be very nearly seven hours and thirty minutes Greenwich mean time, corresponding to one hour and nineteen minutes Glasgow mean time—that is at nineteen minutes past 1, P. M., June 30th, of Glasgow M. T., and when the planets have set to us, the observer at Melbourne, Sydney and Madras, will see the planets above their eastern horizon with their centers only seventy-three seconds apart, and their limbs only one minute apart. It is a source of much regret to the astronomers of Europe and America, that geographic position will prevent them from making either photographic, photometric or micrometric observations of the two planets while in their most favorable positions. Such observations are reserved for the astronomers of the Pacific islands. This fact serves to show the importance to science, of having observatories distributed at short intervals all around the earth, and in both Northern and Southern hemispheres. Thanks to English enterprise, there are good observatories at Melbourne, Sydney, Calcutta and Madras, and their astronomers will no doubt give a good account of themselves in these observations.

The following remarks of Sir Geo. B. Airey, the venerable Astronomer Royal of England, were communicated to the Royal Astronomical Society in December last. I quote them from Monthly Notices of January:

"Different observers will make use of this phenomenon for different purposes. The instrumental measurement of the relative positions of the two planets will give a test of Leverrier's tables in parts of their orbits where it could not otherwise be obtained. I look with much interest to observations of the colors of the two planets. At the conjunction of 1877, November 3d, the distance between the planets rendered it impossible to see them in the same field with a high power on the telescope, and therefore impossible to receive from them any large pencil of light. I did myself observe them with a good surveyor's hand-telescope, and was much struck with the result as to their colors. While Mars had his usual fiery yellow-red color, Saturn was of deep sap-green. How much of this color was due to contrast with the predominant blaze of Mars, I cannot judge. In the approaching conjunction, Mars will be much smaller, and the colors can perhaps be compared more justly."

I may add, that our supposed observer, in making the circuit of the world in advance of the planet, on reaching the Sandwich Islands, or some of the more

western groups, would, if he had a telescope of sufficient power, be able to see Mars pass in between the outer ring of Saturn and his outer satellite, Japetus—approaching this satellite, according to the computation of Mr. Marth, of London, within thirty seconds.

I hope that some of your readers may be induced, even at the expense of a morning nap, to look at these planets, at least on the mornings of June 29th and 30th, and of July 1st.

PLANETARY PERIHELIA AND PESTILENCE.

BY PROF. ELIAS COLBERT.

[The following article, by our friend, Prof. E. Colbert, of Chicago, was written by him in response to numerous letters asking his opinion relative to the theory of Dr. Knapp. We might add, also, that Prof. Watson of Ann Arbor, Prof. W. Harkness of Washington, and other well known astronomers who have also been appealed to, uniformly express a similar opinion to that given below.—EDITOR.]

The years of perihelion passage will be: Jupiter, 1880; Neptune, 1881; Uranus, 1882, and Saturn, 1885. Also, about the 28th of May, 1881, the planet Mars will also be in the perihelion point of *his* orbit. In order to ascertain the momentum of these facts as bearing upon sublunary things, we note:

First.—The perihelion of a planet's orbit is not a substance or thing that can exert an influence, neither is it a point that always preserves the same position in the heavens with reference to the stars. If any effect be due to the passage of a planet through its perihelion, it must be simply because the planet is then *nearer* than when in any other part of its orbit; and it is a necessary inference that the effect may be mathematically correlated to some function of the distance.

Second.—The most reasonable supposition with regard to this interdependence of power and distance is that the effect varies inversely as the square of the distance. That is the relation known to exist in the case of the attraction of gravitation, and light and heat. If it be claimed that the effect is electric, or magnetic, then we have no good reason to suppose that any other ratio prevails, since in the absence of any lineal conductor (as a piece of wire), any definite quantity of power radiating from any point must be distributed over an area the magnitude of which is directly proportional to the square of the distance; wherefore the quantity of power impressed upon a square foot or a square mile of such affected area will be in inverse proportion to the square of its distance from the source of such power.

Third.—The planets are always shining, and each one is always attracting its fellows away from the average path around the sun. It would be absurd to suppose that they are not always acting magnetically, or electrically, if they do so

when in perihelion. It is, therefore, a logical inference that the disasters referred to, if due to perihelion passage, must be due to the excess of the perihelion force above the average force—that is, the difference of the two. This is very nearly equal to the eccentricity of the orbit divided by half the product of the perihelion distance and the mean distance. The mathematical reader can easily verify this statement; the non-mathematical reader must take it for granted.

Fourth.—The gravitating influence of a planet, for equal distances, is directly proportional to the quantity of matter it contains, which, for equal densities, is proportional to the cube of the diameter. If distance and intrinsic illuminating power be both equal in any two or more cases, then the light received would be proportional to the surface—that is, to the square of the diameter. In the case of magnetic or electric excitation, the ratio of exerted force must certainly not be outside these limits. In the case of the superior planets, which are charged with the crime of making their perihelion passages almost instantaneously, it is approximately correct to say that their quantities of matter, and intrinsic luminosities, are in the above-named ratios; so that, without glaring error, we may apply the same reasoning to each of them.

Fifth.—We may now inquire, Is the influence of these planets on the earth a direct one? that is, does it vary with their varying distances from our planet? If yes, we meet at once this important fact, that the differences between their mean and least distances are less than the distance from the earth to the sun. These differences are, for Mars, thirteen millions; Jupiter, twenty-three millions; Saturn, fifty millions; Uranus, eighty-three millions; Neptune, twenty four millions, while the earth distance is between ninety-two and ninety-three millions of miles. The earth, therefore, in each annual revolution, changes her distances from each of these bodies more than the change of distance with respect to Uranus once in eighty-four years, which should give a pestilential visitation every twelve months. In the case of Jupiter, which is claimed by Dr. Knapp and others to be the most potent of all, the difference of distance is only about one-quarter; and, according to the hypothesis most favorable to the theory of planetary epidemic, the difference of action is only one-sixteenth (square of one-quarter) as much every twelfth year, due to Jupiter's period, as it is every year, due to the earth's annual motion. If, when the earth is in line between the sun and Jupiter, we can detect the least excess of electric, magnetic, or actinic force above the mean, we may, perhaps, be justified in asserting that an augment of one-sixteenth part more will cause dire disasters. Otherwise, certainly not. We might easily show figures that the combined excess of all four of the larger planets, when acting together at simultaneous perihelion, would not be more than (say) one-tenth of that due to the earth's yearly change of distance from Jupiter alone. The idea of earth epidemic, as directly due to excessive action by the planets when at or near their perihelia, may, on this showing, be fairly called absurd.

Sixth.—The most plausible hypothesis is that the planets will act on the earth

indirectly—through the medium of the sun; that they will excite him to unusual energy—luminous, magnetic or otherwise—and that this will cause the predicted epidemic. The idea is not new, and has, besides, the merit of having been advocated by some great men. The statement has been admitted into at least one scientific text book, that there appears to be a connection between the periods of sun-spot vigor and the periods of revolution of Venus, Jupiter, Saturn and Uranus. A little figuring will enable us to form some idea of the value of this theory as applied to the case in point. Taking the quantity of matter in the earth and her mean distance as the units of measure, and dividing the mass by the square of the distance, we have for relative power on the sun: Earth, 1; Jupiter, 11.40; Saturn, 1.02; Uranus, 0.04; Neptune, 0.02. The square of the relative diameter being taken instead of the mass, gives: Earth, 1; Jupiter, 4.35; Saturn, 0.92; Uranus, 0.05; Neptune, 0.02.

Applying the above given rule for eccentricity, and multiplying into these numbers, and also multiplying to make the earth the unit, we have:

Planet.	*On Mass*	*On Surface.*
Jupiter	1.255	0.479
Saturn	0.039	0.035
Uranus	0.0003	0.0004
Neptune	0.00001	0.00001

These figures show that, in the case most favorable to the theory, the increased effect due to Jupiter is only about one-fourth greater than that due to the earth, while the power of all the rest is insignificant in comparison. The effect due to the combined perihelion passages of the four greatest planets in the solar system is only about one-third greater than that produced by the earth at the beginning of each calendar year, when she is in perihelion.

The advocates of the perihelion theory may claim that this comparison is unfair, in two respects: First, that the cumulative force of these planets, acting through several years, will amount to much more than if it were operating only during the short time that the earth is nearest to the sun. Secondly, that the larger planets are confessedly much hotter than the earth, and therefore are capable of exerting a very much greater electric or thermal force per ton of matter, or per square yard of surface. Let us, then, take Jupiter as the unit of comparison. The above figures show that his power is increased by only one-thirtieth to one-fourteenth part, at most, by the adjuvant action of all the rest. We are, therefore, not warranted in believing that the combined perihelion passages will work more than three to seven per cent more of harm to the human race than is caused by Jupiter once in every twelve years, or a little less, when he makes his perihelion passage alone.

Of course, no one can assert, knowingly, that the black plague in Russia will not spread over other countries of the Old World or sweep this continent as with the besom of destruction. Such wide-spread devastation has occurred before, and will undoubtedly occur again, unless checked by scientific intervention, as history

always repeats itself. But the above considerations show that it would be entirely independent of perihelion passages.

We may add, in conclusion, that the perihelion passages referred to have not yet been made, and Jupiter, which is certainly the most potent of the lot, if there be any potency in the case, is yet fifty degrees from the perihelion point of his orbit; so that the present plague cannot be due to perihehia, unless we are prepared to admit that the effect may occur before the cause has an existence.

The phenomena, so full of terror to the many, will be welcomed by the astronomer. He will probably be able to find out more than is now known of these planets, especially in the case of Jupiter, whose perihelion passage will very nearly coincide with his opposition to the sun early in October, 1880. He will be pleased with the opportunity which is dreaded by those who, like the silly sheep in the fable, were

"Frightened at the sound
So sweet to huntsman, gentleman, and hound."

—*Our Rest.*

THE GREAT PYRAMID—ITS LOCATION AS RELATED TO SCIENCE.

REV. JAMES FRENCH, DENVER, COLORADO.

Once more we direct our thoughts to Egypt, the wonder land of the globe, whose history and surroundings are without a prototype and can have no reproduction; a kind of dreamland, whose objects and events seem isolated and shrouded in myth, and yet a land easily accessible and full of marvelous realities; the land of Ham, and the embryo cities founded by his son Misraim and his grandson Copt; the birth-land of history and civilization, where the arts and sciences were cradled and wrapped in their swaddling clothes of symbols and hieroglyphics; the land of hoary relics, strange and innumerable—of the pyramids, mausoleums, catacombs, mummies, temples, and obelisks. The land of Thebes with her hundred gates, and Memphis the home of the Pharaohs. The garden-land and granary of the old world, whose Goshen harvests sustained the famishing family of Jacob, and where his posterity, under the heat of privation and tyranny, on the anvil of slavery, were forged into a wonderful theocratic nation; the land upon the bosom of whose sacred Nile was launched that frail ark of rushes which was freighted with the prophet of their God, and their future liberator, lawgiver and judge. The land where, during the reigns of Shischank and Pharaoh Hophra, who were contemporaneous with Rehoboam and Jeremiah, profane and sacred history synchronized. The land where Herodotus, and Diodorus, and Strabo, and Tacitus wrote their histories, and where Plato, Solon, Lycurgus and Pythagoras obtained their education as teachers of philosophy and laws; the refuge of the world's Savior when he fled from the murderous hate of a deputy of the world's master;

a land terribly cursed by Mahommedan superstition, oppression and misrule, and governed by the basest of tyrants, as was distinctly decreed that it should be.

Oh, Egypt! Empress and yet slave! Once attired in robes of transcendent splendor, with pearls and diamonds glittering in thy crown, now sitting in the ashes of thy former glory, disowned, neglected and oppressed! Lift up thine eyes, thou despoiled and despondent queen, and catch that gleam of hope that comes piercing through the ages to thy relief from unfulfilled predictions as sure as those which doomed thee to thy present fate, which, when realized, will make thy throne and crown more glorious than ever.

But we must not linger amid the scenes and events that crowd upon us from every side and whisper from every object and strike us from every breeze, and that cluster around our memories as we stand in the silent and hallowed presence of Egypt's tombs of death and wonders of life.

We are here now, as before, for a special purpose. Our business is similar to that of the philosophers and students whom we quoted, who went there to take lessons in science. And there is one place in Egypt even now, while she is trampled under Mussulmen's feet, which is consecrated to this elevated purpose—one place which the polluted hands of Mahommedanism have not utterly destroyed—one place where we can, as Dr. Young puts it, "drink deep of the Pierian spring." That place is at the shrine of the Great Pyramid, where we have been lingering and learning.

There are peculiarities in the *location* of this massive pile which indicate its erection for scientific purposes, designed to be world-wide in its influences when its purposes become known.

I. *We notice the geographical peculiarities of its location.*

1st. It is at the southern apex of the fan-shaped Delta of the Nile, and therefore remarkably central for all of Egypt, and at the same time about equidistant from any part of the Egyptian coast on the Mediterranean Sea.

2d. It is at the center of the land portion of the globe.

3d. There is more land on the latitude of the Pyramid than on any other latitude on the earth.

4th. There is more land on the longitude of the Pyramid than on any other longitude on the earth.

These are strange facts, which we do not need to prove when we find them admitted by so able a writer as Richard A. Proctor in his elaborate criticism of "The Religion of the Great Pyramid." While he characterizes as fanciful the idea that these facts involve the necessity of superhuman guidance, he frankly admits that they point to the best location possible if designed for scientific purposes. This admission, it seems to us, is all we need; for if we were to prove Divine guidance in the selection of such a location, it could do no more than point to the best possible location. Does it weaken the basis of the inspiration theory that superhuman aid was not present when human aid was sufficient without it?

But suppose it was an additional design in the construction of this wonderful pile, that it should occupy a central position not only for Egypt's benefit but for the world's? That it is thus central, is admitted; and that this center was selected taking into account the Western hemisphere, then unknown, is an undisputed fact. On this hypothesis, is not the inspiration theory a consistent one?

There is one other significant peculiarity in this location viewed from a geographical standpoint:

5th. It is the key or connecting link between the continents of the Eastern hemisphere.

Especially is this the case now between Europe and Asia. So strategic is this location that, taken in connection with the vast granary afforded by the delta, it is a shining mark to attract the ambition of the ruling nations of Europe, where nothing can be done, looking to its occupation by any nation, without exciting the jealousy of others.

II. *We notice the location of the Great Pyramid in its astronomical aspects; that is, so far as it affects the aspects of the heavens viewed from the pyramid as from an observatory.*

1st. It is at the 30th degree of north latitude, or very near it.

It is within one and one-third miles of the exact parallel of 30 degrees. It is between the exact 30th degree and the apparent 30th degree. Owing to the refractive power of the atmosphere, the apparent 30th degree lies about two and one-sixth miles south of the real 30th degree.

Much more importance is attached by Mr. Proctor to its position as viewed from its astronomical relations, than from those which are purely geographical. He says: "It would seem that the builders of the pyramid were anxious to place it in latitude 30° as closely as their means of observation permitted."

It would seem to us that the builders of the pyramid were anxious to place it n latitude 30° as near as the nature of the foundation on which it was to stand would permit.

Mr. Proctor's hypothesis involves an error in calculation of one and one-third miles, which, if corrected, would have placed the pyramid where it would have sunk and been destroyed ages ago. Is it not more reasonable to conclude that the latitude of 30° was known, and that it was built as near to that spot as possible, and at the same time have it stand where it would abide, on "the sure and proverbially wise foundation of a rock?" If the builder designed (as Mr. Proctor thinks he did) to put the structure on the 30th parallel *exactly*, he was not so wise as he has the credit of being; for to have placed it *exactly* on the 30th parallel would have "likened him unto the foolish man, who built his house upon the sand."

METHODS OF DETERMINING LATITUDE.—In explaining the manner of determining 30° latitude, Mr. Proctor is extremely happy, especially in illustrating the advantages of the stellar over the solar method. We will have him speak for himself. He says: "In our own time, of course, the astronomer has no

difficulty in determining with the greatest exactness the position of any given latitude-parallel. But at the time when the Great Pyramid was built it must have been a matter of very serious difficulty to determine the position of any required latitude-parallel, with a great degree of exactitude."

THE SUN METHOD.—"The most obvious way of dealing with the difficulty would have been by observing the length of shadows thrown by upright posts at noon in spring and autumn In latitude 30° north, the sun at noon in spring (or, to speak precisely, on the day of the vernal equinox) is just twice as far from the horizon as he is from the point vertically overhead, and if a pointed post were set exactly upright at true noon (supposed to occur at the vernal or autumnal equinox), the shadow of the post would be exactly half as long as a line drawn from the top of the pole to the end of the shadow. But observations based on this principle would have presented many difficulties to the architects of the pyramid. The sun not being a point of light, but a globe, the shadow of a pointed rod does not end in a well defined point. The moment of true noon, which is not the same as ordinary or civil noon, never does agree exactly with the time of the vernal or autumnal equinox, and may be removed from it by any interval of time between zero and twelve hours. And there are many other circumstances which would lead astronomers like those who doubtless presided over the scientific preparations for building the Great Pyramid, to prefer a means of determining latitude depending on another principle."

THE STAR METHOD.—"The stellar heavens would afford practically unchanging indications for their purpose. The stars being all carried around the pole of the heavens, as if they were fixed points in the interior of a revolving sphere, it becomes possible to determine the position of the pole of the star-sphere, even though no bright, conspicuous star actually occupies that point. Any bright star close by the pole is seen to revolve in a very small circle whose center is the pole itself. Such a star is our present so-called pole-star and, though in the days when the Great Pyramid was built that star was not near the pole, another and probably a brighter star lay near enough to the pole to serve as a pole-star, and to indicate by its circling motion the position of the actual pole of the heavens. This was at that time, and for many subsequent centuries, the leading star of the great constellation called the Dragon.

"This star, called Thuban, from the Arabian *al-Thuban*, the Dragon, is now not very bright, being rated as barely above the fourth magnitude; but it was formerly the brightest star of the constellation, as its name indicates. Bayer also assigned to it the first letter of the Greek alphabet, though this is not absolutely decisive evidence that so late as his day it retained its superiority over the second magnitude of stars, to which Bayer assigned the second and third Greek letters."

"In the year 2790 B. C., or thereabouts, the star was at its nearest to the true north pole of the heavens, the diameter of the little circle in which it then moved being considerably less than one-fourth the apparent diameter of the moon. At that time the star must have seemed to all ordinary observation an absolutely fixed center, around which all the other stars moved.

"At the time when the pyramid was built, this star was about sixty times farther removed from the true pole, revolving in a circle whose apparent diameter was about seven times as great as the moon's. Yet it would still be regarded as a very useful pole-star, especially as there are very few conspicuous stars in the neighborhood.

"The pole of the heavens, we know, varies in position according to the latitude of the observer. At the north pole, it is exactly overhead. At the equator, the poles of the heavens are both on the horizon; and as the observer travels toward the north or south pole of the earth, the corresponding pole of the heavens rises higher and higher above the horizon. In latitude 30° north, or one-third of the way from the equator to the north pole, the pole of the heavens is raised one-third of the way from the horizon to the point vertically overhead, and when this is the case the observer knows that he is in latitude 30°. The builders of the Great Pyramid, with the almost constantly clear skies of Egypt, may reasonably be supposed to have adopted this means of determining the true position of that 30th parallel on which they appear to have designed to place the great building which they were about to erect.

"It so happens that we have the means of forming an opinion on the question whether they used one method or the other—whether they employed the sun or the stars to guide them in the geographical position they required. In fact, were it not for this circumstance, I should have thought it worth while to discuss the qualities of either method. It will presently be seen that the discussion bears importantly on the opinion we are to form of the skill and attainments of the pyramid architects.

"Every celestial object is apparently raised somewhat above its true position by the refractive powers of our atmosphere, being most raised when nearest the horizon, and least when nearest the point vertically overhead. This effect is indeed so marked on bodies close to the horizon that if the astronomers of the pyramid times had observed the sun, moon and stars attentively when so placed, they could not have failed to discover the peculiarity. Probably, however, though they noticed the time of rising and setting of the celestial bodies, they only made instrumental observations upon them when these bodies were high in the heavens, and so remained ignorant of the refractive powers of the air.

"Even that skillful astronomer, Hipparchus, who may be justly called the father of observational astronomy, overlooked this peculiarity, which Ptolemy would seem to have been the first to recognize.

"Now, if they had determined the position of the 30th parallel by observations of the noon-day sun (in spring or autumn), then, since owing to refraction they would have judged the sun to be higher than he really was, it follows that they would have supposed the latitude of any station from which they observed to be lower than it really was. For the lower the latitude the higher is the noon-day sun at any given season. Thus, when really in latitude 30°, they would have supposed themselves in a latitude lower than 30°, and would have traveled a lit-

tle farther north to find the proper place, as they would have supposed, for erecting the Great Pyramid

"On the other hand, if they determined the place from observations of the movement of stars near the polar heavens, they would make an error of a precisely opposite nature. For the higher the latitude the higher is the pole of the heavens; and refraction, therefore, which apparently raises the pole of the heavens, gives to a station the appearance of being in a higher latitude than it really is, so that the observer would consider he was in latitude 30° north when in reality somewhat south of that latitude.

"We have only, then, to inquire whether the Great Pyramid was set north or south of latitude 30° to ascertain whether the pyramid architects observed the noonday sun or circumpolar stars to determine their latitude, always assuming (as we reasonably may) that those architects did propose to set the pyramid in that particular latitude, and that they were able to make very accurate observations of the apparent positions of the celestial bodies, but that they *were not acquainted with the refractive effects of the atmosphere.*

"The answer comes in no doubtful terms. The center of the Great Pyramid's base lies about one mile and a third south of the 30th parallel of latitude, and from this position the pole of the heavens, as raised by refraction, would appear to be very near indeed to the required position. In fact, if the pyramid had been set about half a mile still farther south, the pole would have seemed just right."

Mr. Proctor very readily concedes that, while he presents a possible way of locating the pyramid without any necessity of superhuman aid in doing so, this would not be likely to be accepted as a refutation of the inspiration theory. The point in the argument to which we attach the greatest importance is the agreement with regard to the facts which lie at the base of the whole discussion. But there is still another peculiarity in the location of the Great Pyramid, viewed from an astronomical standpoint, which we regard as worthy of consideration. It is as follows:

2d. The Great Pyramid was located where the distance through the earth, provided it were an exact sphere, of which the surface on that parallel was an arc, would equal, to approximate exactness, the earth's true polar diameter.

This is a remarkable discovery, made by Mr. Proctor in endeavoring to account for the admitted knowledge of the earth's polar diameter by the architect of the pyramid. He says:

"We may agree, in fine, with Smyth, that the builders of the pyramid knew the earth to be a globe; that they took for their measure of length the sacred cubit, which by *their* earth measures they made very fairly approximate to the 20,000,000th part of the earth's mean diameter, but there seems no reason whatever for supposing (even if the supposition were not antecedently of its very nature inadmissible) that they knew anything about the compression of the earth, or that

they had measured a degree of latitude in their own place with very wonderful accuracy."

He adds in a note:

"It may, perhaps, occur to the reader to inquire what diameter of the earth, supposed to be a perfect sphere, would be derived from a degree of latitude measured with absolute accuracy near latitude 30°. A degree of latitude measured in polar regions would indicate a diameter greater even than the equatorial; one measured in equatorial regions would indicate a diameter less even than the polar. Near latitude 30°, the measurement of a degree of latitude would indicate a diameter very nearly equal to the true polar diameter of the earth In fact, if it could be proved that the builders of the pyramid used for their unit of length an exact subdivision of the polar diameter, the inference would be that, while the coincidence itself was merely accidental, their measurement of a degree of latitude in their own country had been singularly accurate. By an approximate calculation I find that, taking the earth's compression at $\frac{1}{300}$ the diameter of the earth, estimated from the accurate measurement of a degree of latitude in the neighborhood of the Great Pyramid, would have made the sacred cubit—taken at one 20,000,000th of the diameter—equal to 24.98 British inches, a closer approximation than Prof. Smyth's to the estimated mean probable value of the sacred cubit."

Unbelievers in the inspiration theory will, of course, with Mr. Proctor, only regard this as another of the wonderful coincidences, or curiosities, abounding in this old rocky pile. But we see no objection to conceding that they might have found the polar diameter in this way, so long as they found it accurately. To us it is an additional marvel that such a measurement should so exactly correspond with the earth's real polar diameter. Is not this what might be called in court phrase cumulative evidence? To say of the wonderful coincidences abounding in the Great Pyramid that they are remarkable, or that they are curious, is, it seems to us, not at all responsive to the facts in the case. To us they are all this, and a great deal more. Like the successive steps of a theorem in geometry, the more one admits the more he must admit. Cumulative evidence we cannot resist, and if the earth's exact polar diameter, and sun's distance, and other facts of comparatively recent discovery are found built into its structure, we think consistency must compel us to withdraw from Copernicus and Kepler and Newton and others the credit history accords to them as discoverers, or admit that the architect of the Great Pyramid obtained his knowledge under Divine guidance.

METEOROLOGY.

THE MAY TORNADOES OF KANSAS AND MISSOURI.

BY PROF. JOHN D. PARKER, KANSAS CITY.

On May 30, 1879, occurred two of the most destructive tornadoes that were ever known to visit the Lower Missouri Valley. This statement is verified, whether we consider the violence of the tornadoes, the extent of territory passed over, the amount of property destroyed, the number of persons injured, or the loss of life.* The accompanying map gives the approximate paths of these tornadoes, which were raging at about the same time, and may have sprung from the same general disturbing causes. These two tornadoes we have named from the towns where they did the most damage, and will treat them as follows:

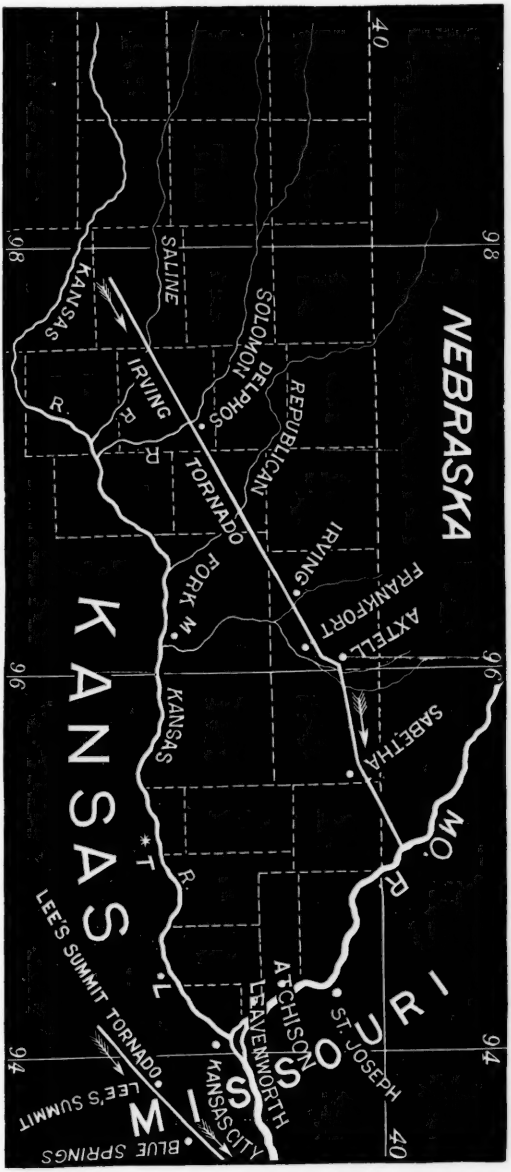
The Lee's Summit tornado seems to have originated near Belton, Cass county, Missouri. In the afternoon of May 30, 1879, there was a heavy shower at Belton, accompanied with hail, while further east another heavy storm was raging. Late in the afternoon these two storms seemed to unite to form the tornado, which passed off in a northeasterly direction. At Raymore, Cass county, several persons state that they saw the clouds gradually approach each other, forming two funnels in the air at the same time, which seemed to approach and play around each other, and then unite to form one mighty column, which swayed and rocked to and fro like a huge balloon, with the roaring and rushing of a thousand locomotives, as it passed on its way, leveling everything before it.

At Lee's Summit the people report the weather, on the afternoon of the 30th of May, as very sultry and oppressive, with a warm wind blowing from the south. Toward evening a cold current of air came down from the northwest, accompanied with hail and some rain. About six o'clock a black cloud from the southwest suddenly burst upon them, and the tornado swept by about two miles south of the town. A correspondent, who visited the path of the tornado, reports that everything in the shape of vegetable life was mowed clean, and the ground torn up in places, especially on hill-sides, as if hundreds of men with shovels had dug it up for a road-bed of some giant railroad. The largest trees were twisted off close to the ground like pipe-stems, or taken up by the roots and carried for hundreds of yards, and then dashed to the ground and splintered, in some cases, as fine as kindling wood. Ponderous rocks were hurled from their beds hundreds of yards

* I take pleasure in acknowledging my obligations to various persons for information furnished in reference to the May tornadoes, especially to Dr. F. A. Ballard and Mr. Charles H. Clark, of Independence, Missouri, and to Dr. Isaac B. Smith, of Frankfort, Kansas, and also to Miss Kate Slosson, a pupil of Mrs. Clara Hoffman, Principal of the Lathrop School, Kansas City, for assistance rendered in preparing the map for the engraver.

and broken into fragments. Buildings and fences were swept away and timbers carried in some instances over a mile and driven endwise several feet into the hard earth. Animals are reported as having been taken up and carried some distance, and let down uninjured.

The people at Blue Springs, about twelve miles northeast of Lee's Summit, liken the tornado to a huge tower of inky blackness reaching to the sky, preceded by a fearful rushing and roaring noise, the mass of the ascending column being perfectly opaque. Passing south of Blue Springs nothing could withstand the violence of the tornado, the most substantial houses in the vicinity of that place being swept away in a moment. Numerous instances are given showing the violence of the storm. The mold-board of a plow was wrenched off and carried some distance; a new wagon was wrecked, the spokes being wrenched from the hubs, and the tires bent into a variety of fantastic shapes. Trees were stripped of their bark and looked as if scorched, which phenomenon was



first attributed to electricity, but afterward found to be a discoloration by a peculiarity of the sap. Prostrated trees were found lying some at right angles to the path of the tornado, and some pointing toward the vortex. Evidences are abundant that the funnel of the tornado contained a large amount of *debris*, and mud having a sulphurous odor, which was dashed with tremendous force and plastered over every obstacle remaining in the path of the tornado. A fence near Blue Springs, running east and west, was thrown down, the west end toward the south, the east end toward the north, showing the direction of the currents. A short distance beyond Blue Springs the tornado seemed to be lifted from the earth, not doing any more damage.

A correspondent, going from Blue Springs to Lee's Summit, says that for several miles the road runs along almost parallel with the track of the tornado, which was nowhere more than three hundred yards in width, and in some places was contracted to fifty yards. Some persons escaped who were caught in the tornado, although instantly blinded, stunned and covered with mud, and carried they knew not whither. The path of the tornado was deflected a little, about three miles southwest of Blue Springs. It seemed to sweep over hills and ridges and through ravines alike, carrying everything before it. It is impossible to give the mass of particulars gathered for this article, and many reports must be taken *cum grano salis*. Some four persons were reported killed, and a large number injured, some perhaps fatally. A correspondent traced the track of this tornado, giving range for the path examined of nine miles east and twenty-one miles north. The tornado passed along an elevated portion of the country, or a divide, the heads of streams along its course flowing from it both east and west. One of the U. S. Signal Corps observers, I learn, traced the path of this tornado back nearly to Paola, in Kansas.

The Irving tornado had its origin probably as far west as Ellsworth county, Kansas, and crossed the Saline river at the mouth of Twelve-Mile creek, where it did its first damage. It traveled in a northeast direction, through Lincoln, Ottawa, Clay, Riley, Marshall, Nemaha, and Brown counties, and passed into Richardson county, Nebraska. The same general storm touched Cawker City and Beloit, Mitchell county, Kansas, at about 2:30 p. m., unroofing at the latter place the tent of a circus which was in full blast, blowing down a number of houses, and twisting large trees in pieces as it passed down the Solomon river; this storm being, perhaps, an outlier or feeder of the main tornado. The Irving tornado passed about four miles south of Delphos, which has since been almost destroyed by another tornado, June 9, 1879.

After passing the Solomon river, the Irving tornado seemed to increase in violence and destructiveness. Some describe its appearance in its approach as "cloudy pillars" resembling smoke, afterward assuming an inky blackness, all rolling, dashing and clashing with each other, as if engaged in a furious battle. The tornado struck Stockdale, Riley county, doing some damage, whence it passed on, crossing the Blue river, lifting all the water out of the bed of the stream, and scooping the water, it is said, out of a well.

The people at Irving saw, just before 5 p. m., a dark mass of clouds gathering southeast of the town. A deep roar was heard, when the clouds began to lower and spin like a top, advancing upon the town and destroying one small house in the outskirts. This seemed to be a prelude, followed by a calm. Suddenly the heavens turned a greenish hue, and, with an awful roar, the tornado burst upon them, leaving the southern portion of the town a mass of ruins.

The tornado then swept onward, with a path from one-half to three-fourths of a mile in width, and when within two miles of Frankfort it passed up the west fork of the Vermillion river, in a north and northeast direction, a distance of fifteen miles, near Axtell, where it turned again upon its normal path and passed on near Sabetha, and into Richardson county, Nebraska. About fifty houses were blown down in the vicinity of Frankfort, and fifty families left destitute.

During the passage of the tornado neighboring towns received more or less damage. Vermillion suffered slightly, some of the houses being started from their foundations. Centralia, Blue Rapids and Waterville received some damage.

I give some singular incidents of the tornado, as related on good authority:

Mr. Fitch's son was blown across a ravine, over trees and fences, and landed unhurt on the door-step of a house half a mile distant. When asked how he came there, he replied, "I do not know!" Mr. Yawger found one of the wheels of his wagon 2½ miles from home. A tire was blown off a wagon wheel and straightened out as well as a blacksmith could do it. The body of a lady was driven into the ground head foremost, covering head and shoulders. A coat was torn from one man, divided in the center, the halves being driven in opposite directions. Some of the fowls were picked clean of their feathers. On Snipe creek, large elm, oak, walnut, cottonwood and sycamore trees were twisted off and torn up by the roots, leaving a fine forest a scene of desolation.

The number of killed and injured have been variously estimated. At Irving and vicinity, thirteen were killed and fifty wounded. At Frankfort and vicinity, five were killed and forty injured. At Delphos and other places large numbers are reported killed and injured. The people along the route of the tornado were engaged in little else for several days but in burying the dead and caring for the wounded.* In Marshall county alone the damage to property and crops is estimated at $150,000.

On May 29, 1879, occurred a destructive tornado in Andrew and Nodaway counties, Missouri. A correspondent says, on that calendar day, at Bolckow, Andrew county, a hot wind blew from the northwest for several hours. The skies had been overcast from early morning with clouds, which frayed off and separated into light-colored masses and drifted away, and finally dissolved in the atmosphere. About three o'clock clouds banked in the west and northwest in heavy black masses, and a current of hot air from the southwest appeared to hurl

*Immediately after the occurrence of the Irving tornado, Governor St. John issued a proclamation calling on the people of Kansas to render assistance to the sufferers, heading the subscription himself with a liberal contribution, and all has been done that is possible to relieve the sufferers.

them in wild wreaths like battle clouds on one another. About four o'clock the citizens were startled by seeing a wild funnel-shaped cloud appear in the west, and sweep onward as if to doom their town to destruction. Its muffled thunder roar was soon distinctly heard, and immediately it swept by the town upon its destructive mission. The track of the tornado lay about three miles northwest of the town, and presented the looped and ragged edge, so often seen in tornadoes, on the south side. Observers say the tornado at times seemed to stop and take a backward turn, and then sweep on with renewed force, making the loop in the sweep on the south edge. In this manner the tornado would destroy alternate pieces of property, leaving, perhaps, a house standing in the loop unscathed. The tornado passed about a mile north of Barnard, Nodaway county, and, when last observed, was moving toward Conception, Nodaway county. The violence of the tornado was very great; large trees, two and three feet in diameter, were twisted off, and the most substantial houses were lifted into the air and dashed in pieces. In one place it swept through a ravine, lifting out of its narrow walls every stick of timber, so that the bed of the ravine seemed to have been swept with fire. The northward tendency of this tornado in translation was probably due to surface currents.

Samuel W. Rhode, U. S. A., Sergeant of the Signal Corps, of Leavenworth, has kindly furnished notes, from the Journal of that station, on the storm of the 29th of May, which are as follows:

"This evening one of the most severe storms that has visited this section for several years past, passed over this station. During the afternoon the sky was partially, and sometimes fully, covered with heavy, cumulus-stratus cloud, moving rapidly from the southwest. The wind was blowing briskly from the south, with a low and steadily falling barometer and rising temperature. At 5 p. m. a heavy dark mass of 'thunder heads' appeared on the northwest horizon, and gradually moved eastward, increasing in bulk and extending toward the zenith. Frequently, during the formation and development of the storm cloud, as many as four different currents in the air were indicated by the movement of the clouds. The 'cyclone,' or spiral, motion of the wind was plainly discernable in the clouds for over an hour before the force of the storm was felt at the surface. Rain could be seen falling to the north of the station for ten minutes before there was any precipitation here. It looked like vast and dense volumes of fog impelled eastward at a high velocity. At 6:35 p. m. a few scattering drops of rain began to fall. At that time the heaviest portion of the cloud was directly north of the station, the apex being about 60° above the horizon, the wind blowing in fitful gusts from the south. At 6:58 p. m. the barometer reached its lowest point, the actual reading (corrected for temperature and instrumental error only) being 28.670. At 7 p. m. the wind suddenly backed from south to north and increased in force, blowing for about five minutes at the rate of sixty miles per hour. The cloud then moved rapidly southward, trending toward the east. The rain fell in perfect torrents for near an hour. From 7:10 to 7:40 p. m. considerable hail fell: a number of stones

were measured and averaged from ¼ to ⅜ of an inch in diameter. The electrical discharges were very intense and almost constant. The force of the storm expended itself about 8:05 p. m. The rain cea ed at 8:15 p. m., and the amount which fell in one hour and forty minutes was one inch and forty-three one hundredths.

"The storm produced no serious damage in this city or vicinity. A large number of trees in the city were blown down, and several large buildings suffered damage by lifting of roofs. Fruit trees and growing grain were somewhat damaged by the hail. The position of fallen trees, in different portions of the city, plainly indicated the spiral motion of the wind. The large iron bridge over the Missouri river at this point, on which was a train of heavily laden cars, swayed so much that the engineer jumped from his engine, thinking the bridge was toppling over.

"At about the same hour, a very destructive tornado struck the earth north of this station, near St. Joseph, Missouri. No doubt the disturbance felt here was an offshoot of the above mentioned tornado.

"During the evening, from 9 to 11 p. m., the electrical display in the south, southeast and east was very beautiful and vivid. The heavens were almost continually illuminated. Frequently there were seen as high as a dozen streaks of lightning, of the zig-zag form, which seemed to radiate from a common center."

Several theories have been advanced in reference to the causes of tornadoes. In the present article I have only space to discuss one of them.

Storms are supposed to find their origin, according to the Thermal theory, in an unstable equilibrium of the atmosphere due to solar heat. About three-fourths of the sun's rays pass through the atmosphere, and are absorbed by the surface of the earth. The envelope of the earth is thus heated mainly at the bottom, while it loses most of its heat by radiation at the top. As an increase of heat diminishes the density of the air, the envelope of the earth is in a constant state of unstable equilibrium. The upper and heavier strata of the atmosphere tend constantly to descend and force up the lower strata. Vertical currents are thus formed over greater or less areas of the earth's surface by solar heat every day. The vapor contained in the air is thus carried up by the ascending current until it is condensed into cloud by the expansion and cooling of the air which contains it. The latent heat of the vapor thus liberated tends to elevate the temperature of the air containing it, causing it to be lifted to still higher altitudes. The violence of this upward movement is largely due to the amount of vapor, or the "steam power of the air."

The center, or core, of a storm sometimes becomes a tornado, which possesses a linear and gyratory movement. Connected with these there is a swaying movement, caused by obstacles, such as hills and forests, along the path of the storm, and sometimes the tornado seems to be drawn up into the air.

I have noticed quite a number of whirlwinds observing the laws of tornadoes. In 1872 I saw a beautiful whirlwind at Burlington, Kansas. While walking

toward the town from the northwest, I heard a rushing sound southwest of me. Soon I saw the prairie grass swaying violently, and I had a perfect view of a miniature tornado, as it passed across the road a few rods ahead of me. The atmosphere was tranquil at the time. Here was a whirlwind plowing its way through a tranquil atmosphere at the rate of ten miles an hour, moving east by twenty degrees north, and gyrating in a direction contrary to the hands of a watch.

Tornadoes in the northern hemisphere are translated toward the east by about twenty degrees north. Deflections from this direction are supposed to be occasioned by local causes, such as rivers, surface currents, etc. The Irving tornado was deflected from its path near Frankfort, passing up the west fork of the Vermillion river, in a north and northeast direction, a distance of fifteen miles, when it again resumed its normal path. North of the equator, tornadoes revolve in a direction contrary to the sun, or the hands of a watch with its face upward, while south of the equator they revolve in an opposite direction.

Tornadoes, according to this theory, originate in disturbing causes acting suddenly, but take their character from the cosmical conditions of the globe. The average temperature of the globe is about 85° at the equator, decreasing to about zero at the poles. This excess of heat expands the air in the equatorial regions, which flows over toward each pole. The larger portion of this circulation, however, is confined to a belt not extending beyond the thirtieth parallel of latitude, because the current is cooled in the upper regions, and the meridians narrow toward the poles.

As the atmosphere is carried around with the earth in its daily revolution, the greater the elevation the greater the velocity eastward. A stream descending from the upper regions of the atmosphere would be impelled by its inertia when it reached the earth in an eastward direction. As parallels of latitude decrease in diameter from the equator to the poles, every parallel, going from the equator, revolves with less velocity than the preceding one. Should a portion of the atmosphere become saturated and unduly heated at the surface of the earth, it would be forced up by colder and heavier air. Currents of air would be formed blowing toward a common center. In the northern hemisphere those from the north would naturally find the center moving eastward with a superior velocity, and, falling behind, be projected toward the west, while those from the south would find the center moving eastward with an inferior velocity, and be projected toward the east. The north half of the tornado would be impelled westward, and the south half eastward, establishing the whirl, or vortex which is a low barometer. The currents descending into the vortex on the south side having a greater impulse eastward, from the earth's rotation, than the impulse of the currents westward descending on the north side, the tornado would be deflected toward the northeast. The liberation of the latent heat by the condensation of the vapor, would be the "steam power of the air" to drive up the ascending current; large amounts of electricity would be developed for destructive purposes, and the tor-

nado would sweep on its path to overwhelm towns, crush forests, lick up rivers, and make the solid earth tremble.

The Thermal theory only uses heat, under cosmical conditions, as the *motive* power, leaving much of the phenomena to be accounted for by electricity and other destructive agencies.

Modesty should cover all theories of these awful but occult visitors like a garment A few golden threads are in our scientific fingers, but the theoretic fabric for tornadoes is still largely to be woven. Do not let us imitate that great German scholar who in his mature years found the works of his earlier life the hardest ones to answer.

There need not be any special alarm about tornadoes. Like great comets, they seldom appear, but on that account are the more noticeable. Destructive tornadoes only occur during dry seasons, and then, in this latitude, only on the last few days of May or on the first few days of June. The greatest tornado on record occurred June 3, 1860, the year of the drouth. It passed over a large portion of Iowa and Illinois, destroying Camanche, and killing fifty persons. That would not be an unusual railroad accident or ocean disaster. We stand a hundred chances of being killed in ordinary travel to one chance of being killed by a tornado. Still, we take our sleeping berth and fall into a quiet slumber. Tornadoes also occur just before evening, and, if we remember the law of their movement, we can generally escape them. Although, then, we may never be killed by a tornado, still it is always well to keep a clear conscience.

PARADOXICAL PHENOMENA IN ICE CAVES.

J. RITCHIE, JR., BOSTON, MASS.

The explanation of the phenomena peculiar to ice caves, for which a theory was advanced in the last number of the REVIEW, by Mr. N. M. Lowe, a Boston gentleman, and member of the Boston Scientific Society, has been a matter of interest to scientists for the past two centuries—an interest that may be considered as beginning with the publication of notices and theories in the *Memoires* of the Royal Academy of France, as early as 1699. The most complete and valuable work on the subject is that of the Rev. George Forrest Browne, entitled "Ice Caves of France and Switzerland," published by Longmans, and now out of print. The best informed of scientists, even, are not aware of the mass of matter that has been written and published on this subject, owing to its wide distribution through the proceedings of so many learned societies. The work of Mr. Browne is at once surprising, not only from the thoroughness with which he has studied his subject, but from the vast amount of labor undertaken by him, and the extent of his really valuable original investigation, carried on in a truly scientific manner, and including, as it does, the results of his personal exploration of a dozen of these

caverns. Having personally, and without a knowledge of the previous work of Mr. Browne, gone over a considerable portion of the references so well consulted by him, the credit due to that gentleman strikes us the more forcibly; but as our investigations have been with regard to the applicability of Mr. Lowe's theory, our own results may from time to time serve to throw a little more light on the subject.

The question of the temperature of ice caves, has ever been a bone of contention among observers, whole pages of the *Memoires* (1712) being used in the discussion of the results of another writer, by M. Billerez, whose own standard is itself vaguely rendered as *tres-grand froid;* and again, M. Boz, declares the caves to be warmer in summer than in winter. Lately, M. Thury, of the Academy of Geneva, in an account of a visit to the *glacieres* of the Jura and Vergy Mountains, (*Bib. Univ. Arch. Sci.*, 1861, p. 149), states that it is perfectly just to say that ice does not form there in winter, but rather in the fall, and, above all, in the spring, when the snow begins to melt. Mr. Browne, on the other hand, is inclined to reject the question of a winter thaw, so far as concerns the ice caves that he has visited, although the latter point is strongly held by the peasants, but at the same time cannot disbelieve the evidence brought forward to support the idea of a winter thaw in the other caves, which he had not as yet visited. Without attempting to discuss the matter of a complete disbelief of the statements of the country people when antagonistic to the opinion of an observing scientist, we will consider the thaw as out of the question in the caves visited by Mr. Browne, and, with the theory of Mr. Lowe, it makes but little difference whether this point is admitted or not, for it is only a side issue at most, but there still remain a number of caves where the winter's thaw may be considered as well as established.

In regard to theories, all scientists have not been as temperate as was M. Thury, who, in the same article as that above referred to, states the most important thing to be the collection of facts, Mr. Browne's work not having been published until some years later, and he hardly considered that there were enough collected to verify any theory whatsoever. The theory advanced by M. Billerez, Professor of the University of Besançon (*Memoires*, 1712), was based on the supposed action of nitrous salts in the earth above the cave, which, disintegrated by the heat of summer, were readily dissolved by the downward streams of water and in some way formed a freezing mixture. M. Boz, Royal Engineer (*Memoires*, 1726), melted ice to find the salts, and finding none, he disapproved of this theory, substituting instead a line of gorges contracting as they approached the mouth of the cave, and blowing into it the cold wind. M. Cossigny desired very much to connect with the phenomenon a *talus* of soft earth (*Memoires des Savants Etrangers*), which *talus* was considered by Mr. Browne to be the mud washed down a slope of snow by the rains. In 1789, M. Prevost considered the cave to be a natural ice house, owing to the non-conductibility of the material of which it was formed; and later, M. Cadet published an evaporating theory, in which the trees on the top of the hill, above the cave, played an important part; but, on the

authority of Mr. Browne, the circumstances upon which he based his theory were wanting. Prof. Pictet (*Bib. Univ.*, 1st ser., xx.) gives an account of a tour in the Jura Mountains, which has been translated and published in the *Edinburgh Philosophical Journal.* He attempted to account for the phenomena by a system of cold currents, producing evaporation; but his theory was combated and disproved the same year by M. Le Duc.

In reference to the cave of Illetzkaya-Zastchika, Sir John Herschel (1842) expressed his opinion that the evaporation theory was not a probable one, and substituted a wave theory, that seemed so unlikely that Sir Roderick Murchison, in his *Geology of Russia*, makes mention of it, but expresses himself of the opinion that it is not in accordance with the observed nature of the case. This theory, as well as that suggested by Prof. Piazzi Smith in the case of the ice cave in the peak of Teneriffe, was, briefly, that the winter's wave of cold would be retarded in its progress by the non-conducting power of the hillock in which the cave is situated, and would reach the cave in summer, and *vice versa.* It is curious, how so great a scientist should refer to so complex a cause phenomena which can be explained in a so much simpler manner. In regard to the cavern of Teneriffe, it lies at an elevation of 11,000 feet, and is, in consequence, not far below the level of perpetual snow. The circumstances here are favorable to the formation of ice by the process described by Mr. Lowe, the whole quantity of water and snow falling on its top being carried away by internal conduits, the sides of the mountain being free from the scoring produced by streams of water. The elevation and the low average temperature would seem, however, to admit of almost any desired explanation, whether of external temperature, non-conduction, or the effects of the previous winter's cold and ice.

The subject of ice caves had by this time excited considerable interest in this country, and at various times from 1838 to 1861, theories were suggested by various American scientists. Notices and discussions are scattered through the various issues of the *American Journal of Science and Arts* (Silliman's), but no distinct theory appears to have been given until that of Prof. Loomis, read before the American Society for the Advancement of Science, in 1860, but not appearing in its report, is probably not in print. A discussion of it may be found in *Hitchcock's Geology of Vermont* (i., 204), and it appears to have been that cold air has a tendency to descend; rivers or streams flowing through caves have a tendency to raise the temperature of the air, and the absence of these streams allows it to remain cold; hence the ice. This theory, which appears to have been quoted from memory, was disapproved of by Prof. Hitchcock, who declared that in that case all caves containing moisture and no running water would be ice caves. Hitchcock suggested an evaporation theory, but his main subject is rather a particular well in Brandon, Vt., and a peculiar phenomenon, rather than the general one of ice caves, and the larger portion of his arguments are for this reason special in their application.

[*To be Continued.*]

MINING NOTES.

RECENT FACTS FROM COLORADO.

BY JOHN K. HALLOWELL, ROSITA, COL.

(*Continued.*)

In the May number, by some mishap, I mentioned the "Maine" mine as being on the *north* foot-hill of Mount Tyndall, when it should have read *south* foot-hill. Approaching the foot-hill from the south side, the eye first catches a bold out-crop of rock on the southwest end, and about 200 feet above the gulch, and exposed from twenty-five to fifty feet above that point. The hill is about 250 feet high, and connected with Mount Tyndall to the east by a rising, curved slope. To the west it drops off quite rapidly to the level of the gulches that surround it on the three sides, viz.: south, west and north. On climbing to the rock out-crop, it is found to consist of an immense number of rounded boulders, bound together by an entirely different material acting as a cement, which appears to be mainly iron deposited from a water solution.

In the summer of 1877 Mr. E. C. Bassick, examining an old hole on an abandoned claim, found a small piece of horn-silver, and re-located the claim, commencing work at once near by, pay ore being found at the surface, which has continued down 240 feet with no present appearance of its giving out. The whole deposit consists of boulders of various sizes and surrounded with a scale of very rich pay mineral. The composition of the minerals is galena, zinc, tellurides, and free gold. The main shaft was put down 12x24 feet, and all was ore that was taken out, but the deposit enlarges as it goes down, and also increases in richness. Experts who have examined the mine estimate that there is left in sight more pay ore than has been taken out by four times. The value of the ore for the first year was considerably over $400,000. For the past year work in the mine proper has not been prosecuted very vigorously, but, nevertheless, a large amount of other work has been done, with a view to the future development and working of the mine. A tunnel has been run from the south side of the foot-hill and meets the main shaft at a depth of 180 feet. Here an engine room has been hollowed out of the rock, and most perfectly timbered, as well as the tunnel. This work having been completed in the last few weeks, a large force has been put on the mine proper, and work, by three shifts of men, pushed right along without intermission, and an immense amount of rich mineral is coming out. The zinc has some copper pyrites with it, and is very rich in gold. I saw one assay made that gave ninety-seven ounces, twenty-nine and a fraction of which were gold, the bal-

ance silver. The ore is all sorted before being shipped, and fifteen to twenty men are employed with small hammers, chipping the ore off the boulders and sacking the same for shipment to Denver, where it is treated at the reduction works managed by Prof. Hill. The formation and richness of this mine make it, without a doubt, the most remarkable on this continent. Rumor has had it for some time that the mine has been sold to Eastern capitalists for one and a half million dollars.

West of here, about three miles, a new discovery has been made, very similar in formation to the Maine mine, with the exception of the rich pay, but as it is only a prospect so far, it may by developing prove in time to be equally as good.

Coming back to Rosita, we find some of the older mines that first drew attention to this part of Colorado, situated on a continuous vein, viz.: the Virginia, the Humboldt, the Pocahontas, and the Southeast Leviathan. This vein was discovered on the 9th of April, 1874, and the first discovery, named the Humboldt, was sold for about twenty-five dollars' worth of pork and flour. At a depth of fourteen feet, one-half sold for one hundred dollars, and at one hundred feet depth one-eighth sold for five thousand dollars, and in September, 1875, one-half sold for thirty-two thousand dollars cash, the claim passing into the hands of the Humboldt Silver Mining Company, who also purchased the South Humboldt and West Virginia claims. In connection with this mining enterprise, the Pennsylvania Reduction Works were built for the purpose of reducing the ore produced, and afterward the capacity of the works was doubled, that the company might also do custom work for other mines. However, most of the ores produced not being adap ed to their method of reduction—viz., chlorination and amalgamation—and their own mines having been worked down to a fault in the vein, so that comparatively little ore was produced, a few weeks ago the works were shut down, until leased by the Silver Cliff Milling Company, who had the misfortune to lose their own plant at Silver Cliff by fire.

The product of the Southeast Leviathan up to January 1, 1878, was $4,300, value per ton, $86; of the Pocahontas to same date, $317,477.51, value per ton, $124; the Humboldt, $225,604.15, value per ton, $107; the Virginia, $18,547.85. Total, $565,929.51. Since January 1, 1878, the out-put from these mines has been comparatively meager, the Humboldt and Virginia mines having worked into a fault, and the Pocahontas into a lawsuit. I cannot say which is the worst, but all are in the same category so far as products are concerned. The Humboldt, however, is putting up machinery and building over another shaft on their vein, where they have had pay mineral from the surface. To the admirable report of Prof. R. Neilson Clark, I am indebted for all of the foregoing facts and statistics.

Of recent discoveries, the Leavenworth has worked into a fine body of pay ore, milling 160 ounces per ton, and been sold at what the owners consider a profitable figure, I presume. The Custer County Tunnel Company, after drift-

XUM

ing through 300 feet of the hardest kind of rock, on the south side of Robinson Hill, came into a vein of mineral that assayed, to start with, 168, 198, and 333 ounces of silver; this at a depth of about 2 o feet from the surface. Added to these, must be g ven the most recent big strike, one mile northeast of Rosita, adjoining the granite formation, of horn-silver, four feet from the surface, an assay of which I saw weighed at the rate of 4,260 ounces per ton. But the big assay of all came from Silver Hill, ten miles east of here; a small piece of quartz float, showing free gold, gave over $200,000 per ton. For two or three years similar pieces have been found in that neighborhood, but up to date the lode from which they have come has not been discovered. Its being found, however, is only a question of time, as somewhere in the neighborhood it must be.

From the foregoing facts given, I think you will agree with me when I state that this part of Custer county compares favorably with any other part of Colorado, for the length of time that its mines have been worked, and considering that they never had the advantage of outside capital that recent mining camps have got, all that has been done being the result of hard, steady work; and the total value of the out-put up to date must reach near one and a half million dollars.

That there are many more and perhaps richer mines to be developed in this immediate neighborhood, I am confident; and, so believing, I have stuck my stakes here, hoping, by a requisite amount of pluck, energy and hard work, to be one of those who will be successful in helping to find them.

Some weeks ago I heard a railroad man say that, by climbing any of the water tanks along the western end of the Atchison, Topeka & Santa Fe Railroad, as far as the eye could reach, covered wagons would be in sight, within hailing distance of each other, *en route* for Colorado. Within the past ten days the advance guard of "prairie schooners" has arrived here, and every good gulch and spring in this vicinity has more or less campers. I trust the idea is not prevalent among them, as it is with some I have conversed with who came through by rail, and were disappointed that they could not walk up to the nearest hill, fill their carpet-sacks with silver bricks, and go home to spend the rest of their days without further toil or care. Well, they generally go home fully as soon as they contemplated, but the material for the silver bricks stays here, for all they do to obtain it. Mining is a business, and should be entered into the same as any other pursuit; but it will take labor, knowledge, judgment and capital to make a profit from it, and, while the individual investment may be very small in proportion to the profitable returns, the aggregate investment may be more likened to the oil well investments, which at one time, I heard a competent authority estimate, did not pay one-half of one per cent on the total sum expended.

General Tannatt estimates the accessions to the population of Colorado at 490 per day, average. For the year that would give a total of nearly 179,000. Verily we must make arrangements for another representative in Congress, and begin to put on airs.

THE SILVER MINES OF SOUTHEAST MISSOURI.

Hon B. B. Cahoon of Fredericktown Mo., states in an interview reported in the *Plaindealer* that the silver mines of southeast Missouri will soon give to region unprecedented prosperity. He states that one silver mine (that at Silver Mountain) has already been sufficiently opened, by following beneath the rocky surface a true fissure vein of argentiferous galena, bearing silver yielding from fifteen to ninety ounces of silver bullion to the ton of ore, from which, even now, when it is not yet fully opened, over one hundred tons of this ore can be taken out crushed, cleaned and dressed every day, at but a nominal figure, not exceeding eight dollars per ton, which will yield a net profit of at least fifty dollars to the ton. This is the situation of this mine in its infancy. I believe that vein goes to the center of the earth, and becomes richer the further it is followed. Already the company operating this mine have over five thousand tons of this ore out, and its yield from the surface was such that the ore now out will more than pay for opening the mine, erecting the present works, improvements, etc., now nearly ready to begin the crushing and smelting of the ore, and which, experts inform me, are cheap if they have not cost no more than $175,000. So much for what we can see. Any person aquainted with the geological characteristics of the volcanic region bordering upon the St. Francois and Castor rivers, and who has given attention to the matter of what rocks are necessary to be in juxtaposition to bear silver, must be convinced that the granite and porphyry formation, interspersed as it is with veins of quartz, which lines these rivers and the territory adjacent to them, as it runs from the lower part of St. Francois county through Madison, Wayne and Reynolds counties, are silver bearing and that is not too sanguine to believe that this silver found and already exposed at the Silver Mountain, is but the outcropping of the same true fissure vein, which permeates those regions. I am convinced that a very few years (may be but a few months) will demonstrate that we have silver in as profitable quantities as is to be found in Colorado.

Fairplay *Flume*: "Several large transfers of Summit county placer claims have been made during the winter and one or more quite recently, and everything seems to indicate a prosperous mining season there. So many prospectors are diverging from Leadville to all adjacent points that this county is sure to be thoroughly gone over for lead mines as well as placer. We believe that when 'proved up' by systematic work, not Ten Mile alone, but many parts of Summit county will open as fine mines as any in the State. It would be strange indeed if such an interval of barren hills should interpose between the rich districts of Boulder, Gilpin and Clear Counties on the north and Lake and Park counties on the south, especially with its wealth of gulch gold already proven."

XUM

SCIENTIFIC MISCELLANY.

BARFF'S NEW PROCESS FOR PRESERVING IRON.

Professor Barff lately gave a lecture in London on the results obtained by his new process since its first announcement, about two years ago, an account of which was then published in the *Scientific American*.

The process consists, in brief, in subjecting the surface of the iron to the action of super-heated steam at a high temperature. The result is the production upon the surface of the iron of a hard, smooth and durable skin of black oxide of iron, which prevents rust far better than any paint, lacquer, rubber, or other compound or process heretofore known.

Iron articles to be treated by this new process are first cleaned with dilute sulphuric acid, and afterward with bran water. They are then placed within a muffle, the temperature of which is 500° or 600° Fah.; dry super-heated steam at a temperature of 1,00 ° Fah. is admitted, atmospheric air being carefully excluded. The formation of the black oxide skin rapidly takes place.

This coating has peculiar properties. It is so hard that it resists emery powder and the file. Many substances which adhere to ordinary iron will not stick to this prepared iron. For cookery the new process is especially useful. Barff stewpans and other utensils are more cleanly, as arrowroot and other substances can be cooked in them and the vessel cleaned with great ease. Barff vessels can be heated red hot without injuring the skin. Barffed iron is proof against damp, water, hot or cold, and stands exposure to the weather far better than galvanized or painted iron. Barffed boiler and ship plates, whether of iron or steel, are superior to all others, as they do not corrode, and sediment does not readily adhere. The process is applicable to almost every conceivable form of iron manufacture, and appears to be a scientific, important and valuable contribution to the industrial wants of the world.—*Scientific American.*

WHEN the excavations at Olympia were first undertaken, the German Postmaster-General, Dr. Stephen, drew attention to a passage in Pausanias' description of Greece, in which he mentioned a statue that had been erected in honor of a courier of Alexander the Great, and begged that special search might be made for it. News has just reached Berlin from Olympia that the base of this statue has been found, with a well preserved inscription which runs thus: "To the King Alexander's Runner and Traverser of Asia, Philonides, son of Totos, from Kretan Chersonesos, this was dedicated for the Olympian God."

BOOK NOTICES.

THE GEOLOGICAL RECORD FOR 1876; Edited by Wm Whitaker, B. A., F. G. S., of the Geological Survey of England; pp 415, octavo, London: Taylor and Francis, 1878.

This is an account of works of Geology, Mineralogy Palæontology, published during the year of 1876, and is the third of a series commenced in 1874. The volume is divided into stati-graphical and descriptive geology; Physical Geology, Applied and Economical Geology, Petrology, Mineralogy and Palæontology, each of which divisions have been made up by competent sub-editors, such as Messrs Tapley, Lebour, Drew, Tawney, Etheridge, Bonney, Rudler, Miall, Nicholson, Carruthers, Woodward and Dalton. The works consulted number hundreds, and the information derived from them has been condensed to the greatest advantage. As a book of reference to students and amateurs there can be nothing more useful and convenient, since geological works and magazines from every country on the globe are represented and referred to in it, and of course scarcely any single point of interest left unnoticed.

HEARING, AND HOW TO KEEP IT. by Chas. H. Barnett, M. D. 12mo pp 160; 50c.
LONG LIFE, AND HOW TO REACH IT. by Jos. G. Richardson, M. D. 12mo. pp 160, 50c.

These are the first and second volumes of the American Health Primers, announced in the June REVIEW as about to be put forth by Lindsay and Blakiston of Philadelphia, and are well worth careful perusal by all interested, (and their name is legion). Written by eminent and able writers, the respective subjects are discussed in a familiar and common sense manner that will render them especially popular, while the titles alone will attract readers from all classes. The "ounce of prevention," as well as the "pound of cure," is well put forward in both books and the rules of action are so plain and simple that it seems easier and more natural to follow than to disregard them. No purchaser of these or the succeeding volumes of the series will regret it.

HAECKEL'S GENESIS OF MAN. By Lester F. Ward, A. M. pp 64, octavo.

Professor Haeckel, in his late work, "The Evolution of man," of which the pamphlet above named is a condensed exposition, gives the latest doctrines of the

Continental school of evolution in its application to the history of man, and Prof. Ward unquestionably reproduces very closely the position and views of the great German naturalist and philosopher; so that to those desiring to obtain in brief an understanding of these views and beliefs without being at the expense of buying the work itself, now advertised by the Appletons, and the subsequent trouble of following out the argument of the author, this little *brochure* will be of great service.

EDITORIAL NOTES.

WE issue the July number of the REVIEW a few days in advance, in order that our readers may have the benefit of Professor Pritchett's interesting article on "The Conjunction of Mars and Saturn" in time to make such observations of the phenomena described as they may desire and have the facilities for, on the mornings of June 29th and 30th and July 1st. As suggested by Prof. Pritchett, it will pay to lose an hour's sleep on those mornings for the sake of witnessing so rare a spectacle.

THE Missouri Press Asscoiation held its annual session at Columbia on the 27th and 28th of May, and the meeting was largely attended by the fraternity. Its exercises were very interesting, but, as they have been made public by every daily and weekly paper in the State long since, we will only remark that these meetings are being better managed and are becoming more important with each succeeding year, and that the essays, orations, poems and papers presented and read were, in many respects, superior to those of previous sessions.

Of the people of Columbia, who are so constantly and continuously called upon for the exercise of hospitality, by reason of the numerous visitors to the various institutions of learning located there, it is but little to say that they were untiring in their efforts to make our visit pleasant, and that they succeeded in the fullest measure. Our personal thanks are due to the family of our old friend and fellow curator of the University, R. L. Todd, Esq., for intellectual, æsthetic and gastronomic entertainment of the most excellent quality, and to Professor Swallow for an invitation to examine the largest and finest geological and mineralogical cabinet in the West, one to whose collection and arrangement he has devoted the greater portion of a studious and laborious life.

The importance and value of the Missouri University has not been adequately understood even in our own State, notwithstanding the able and vigorous efforts of its Faculty and of such effective co-workers as Major Rollins, Col. Switzler and others who have taken a life-long interest in its welfare; but, doubtless, from this time on, when the question of abundantly sustaining the University shall arise in the Legislature, the press of the State will be found ably and intelligently advocating liberality in appropriating money in its behalf.

Of the excursion to Toledo, Detroit and Put-in-Bay Island, nothing remains for us to say except to express our personal obligations to the officers of the North Missouri, Wabash, Michigan Southern, Michigan Central, and Chicago & Alton railroads for unremitting courtesies at all times, to the members of the press at Toledo and Detroit for overwhelming attentions, and to Capt. J. H. Turner, President of the Missouri Press Association, for his excellent management which made the whole affair a perfect success.

ON account of absence from the city on the occasion of the annual meeting of the Kansas

City Academy of Science, May 27th, we were unable to attend that meeting; but from the reports of it in the daily papers and the statements of those present, we learn that it was well attended and, that the address of Rev. Dr. Marvin was a valuable, interesting and scholarly effort.

The former officers were reëlected, except that Prof. J. D. Parker was elected Recording Secretary in place of E. D. Phillips, Esq., and H. P. Child was made Curator and Librarian in place of Harvey West, who has left the city.

THE tornadoes of the 29th and 30th of May are fully described and discussed in this number of the REVIEW by Professor Parker, to we call especial attention as giving a clear exposition of the Thermal theory on the origin and nature of such phenomena.

THE War Department is considering the question of removing the United States Signal Service station from Leavenworth to this city, for the reason that the facilities for rapidly distributing the Daily Bulletins over a much larger district are far superior here, while the conditions for properly observing meteorological phenomena are alike at both places.

PROFESSOR NORDENSKJOLD has solved a long pending geographical problem by sailing the *Vega* through the Arctic Sea, to the north of Siberia and *via* Behring's Straits, from Europe to Asia. Whether this discovery will ever be of any great commercial value to the world, is doubtful, but the daring feat places his name side by side with those of the most noted navigators of the world.

OUR young friend R. W. E. Twitchell, of this city, quite distinguished himself by an address at the commencement exercises of the Kansas University, upon the subject of The Development of the Race, which has been highly commended by excellent judges.

CYRUS H. MCCORMICK, of Chicago, has become corresponding member of the French Academy of Sciences by unanimous invitation of that body, extended to him upon the death of M. Chevandier de Valdrome, last month. The membership of the Academy of Sciences is limited to eight resident and eight corresponding members.

THE great meteor, weighing 431 pounds, and measuring 2 feet long by 1½ wide, which fell at Estherville, Iowa, May 10th, is to be sent to Chicago for exhibition. It is composed, apparently, of nearly pure metal, of which a finger ring has been made, resembling silver in appearance.

THE twenty-eighth meeting of the American Association for the Advancement of Science will be held at Saratoga, New York, commencing August 27, 1879.

The hotels and railroads will make the usual concessions on rates, and the local committees will do everything in their power to make the meeting pleasant to those attending. For special information, addsess Local Corresponding Secretary, P. O. Box 1071, Saratoga, New York.

The headquarters of the Association will be at the United States Hotel, where the members will report and register. All fees and papers for reading and publication should be sent to the Permanent Corresponding Secretary, Prof. F. W. Putnam, at Salem, Mass., up to August 22d.

THE Missouri newspapers are full of eulogistic notices of the handsome treatment received by them at Columbia, Toledo and Detroit, as well as by the railroad men all along the line.

THE Woodruff Scientific Expedition around the world has been abandoned, and its projector has since died. His death is largely caused, it is said, by the failure of an enterprise in which he had embarked with great zeal and ardor, believing it to be a means of doing great good to his fellow citizens, and in which he had not hesitated to invest all his means.

THE preservation of railroad ties is a matter which must sooner or later engage the atten-

tion of railroad men in this country, as it already has abroad. Germany has taken the lead in experiments of this sort, and the ties on fully half the miles of road in the empire are now impregnated with various chemical solutions. Chloride of zinc appears to be the most satisfactory thing tried, and its use increases the life of ties from 40 to 60 per cent for oak, 60 to 100 for pine 100 to 130 for fir, and 400 to 500 for beech. The cost of treating is six to nine cents per tie for oak, eight to twelve for fir and twelve to twenty for beech, and the increase in length of service, which has averaged fourteen years for pine ties, more than makes up for the expense. As the consumption of ties in the United States is constantly increasing and the area of forests decreasing, our railroads will ultimately have to follow this example or adopt some other material for ties.

GOLD has been discovered in the quartz reefs of the Wynadd district of the Madras Presidency, East India.

NEAR Hamilton, on Tarryall creek, in Colorado, veins of good coal are said to have been discovered seven to eight feet in thickness, which, according to an analysis made by Prof. E. T Cox, State Geologist of Indiana, furnish coke 57.58, volatile matter, 42.42. Being near the present terminus of the Denver & South Park Railroad, this discovery seems to be of great importance.

COLUMBUS, Georgia has been called the "Lowell of the South." It has eight cotton mills besides many other manufactories. The water power at this point is unrivaled. There is a fall of one hundred and forty-seven feet in the river at Columbus, extending for three miles above. This furnishes forty thousand horse power for future use, not including what hasa lready been utilized. The Chattahoochee river is about the size of the Connecticut. There are now in operation here on the river five large cotton mills. Three of these mills are controlled by one company. The three mills run 16,000 looms and 45,000 spindles. They consume about 18,000 bales of cotton annually. Columbus has $3,000,000 invested in cotton manufacturing.

CURRENT LITERATURE.

Through the kindness of Professor William Crookes, F. R. S., etc., London, we have received the advance sheets of his lecture on "Molecular Physics in High Vacua," delivered at the Royal Institution, April 4, 1879. As this article would occupy nearly one-half of a single number of the REVIEW, and involve an expenditure of not less than one hundred dollars for the electrotypes necessary to illustrate it, we are unable to reprint it; but, in view of its transcendent interest and the simplification of its seeming obscurities by means of the beautiful illustrations and the distinguished author's remarkable faculty of explanation, we advise all interested to purchase the June number of the London *Monthly Journal of Science*, and enjoy a rare treat.

MR. GEO. R. TWEEDIE, in the London *Chemical News* for May 15th, describes a new method of producing a coating of magetic oxide on iron surfaces, by first heating the articles and then acting upon them for a certain period by the products of combustion largely mixed with air from a peculiarly constructed furnace, after which a stream of carbonic acid oxide is passed over them for a short time, changing the red oxide to magnetic oxide, which withstands all ordinary oxidizing influences perfectly.

WE learn from the *Engineering and Mining Journal* that the Bessemer medal was awarded, at the late meeting of the Iron and Steel Institute, in London, to the venerable Peter Cooper, of New York, as "the Father of the iron trade of America."

DR. H. C. CHAPMAN reports, in the *Proceedings* of the Academy of Natural Sciences of Philadelphia, for the first quarter of 1879, the dissection of a female chimpanzee five years old, with the following results: The muscular, vascular, alimentary, respiratory, and circulatory systems differ but slightly from

those of man. In the brain "all of the convolutions and fissures described in the human brain can be identified," and "that on the whole the gap between the brain of the chimpanzee and man is less than that between the chimpanzee and the lower monkeys, and that the brain of the chimpanzee resembles that of man quite as closely as that of the orang."

PROF. O. C. MARSH, in his article on Polydactyle Horses, in the *American Journal of Arts and Sciences* for June, describes a number of horses of modern days with one, two, three or more extra toes or digits. One in particular was on exhibition in New Haven a few weeks since, which had an extra digit on the inside of each foot, with a hoof upon it just like that upon the foot itself, except that it was smaller.

THE rejoinder of Prof. Simon Newcomb, in the *North American Review* for June, to the four distinguished theologians who discussed the question of Law or Design? in the May number of that magazine, cannot, in our opinion, be regarded as in any degree settling the controversy, since it is mainly devoted to discussing the positions of the others instead of sustaining the postulate put forth by himself as a basis of debate; and his sole conclusion is the doctrine that "Nature has always been what we see it now;" that "there is neither more nor less of design in any one process of nature than another;" that the creative power "was never exerted in any more striking manner than it is exerted before our eyes at the present time;" that "the creation of all living beings, and their adaptation to the conditions which surround them, are results of a process which we see going on around us every day," and, finally, that the basis of nature is "involved in mystery in every direction," that the "scientist studies it simply to understand the relation of its phenomena," leaving "everything which lies behind or above this for investigation by other methods than those with which he is conversant."

Van Nostrand's Engineering Magazine for June has a most interesting and valuable article by Sir Wm. Thomson, F. R. S. E., F. C. S., upon the Injurious effects of the air of large Towns on Animal and Vegetable Life, and methods for securing salubrious air.

PROFESSOR J. BALL, who has been engaged in scientific researches in Texas for several years past, contributes an article to the *American Naturalist* for June, upon the Geognostic and Agricultural Aspects of that State, which will prove of decided value to all persons intending to remove thither, and to such we confidently recommend it.

FOR reliable and valuable scientific information with regard to the ore formations of Leadville and vicinity, probably nothing can exceed the articles of Prof. Carl Henrich in the New York *Engineering and Mining Journal*. They are the work of an accomplished geologist and engineer and are fully illustrated with sectional drawings of the different mines of the locality.

WE find in the *Hartford Daily Times* an Abstract of a Lecture on the Chemistry of Artists' colors, by Prof. H. C. Bolton, which contains many facts of interest to popular as well as scientific readers, relative to the history of the painters' art and the importance of a knowledge of chemistry in the mixing of colors, &c.

Harper's Weekly states that "saucissenkartoffelbruchsauerkranzwuurst" is a favorite German dish, and adds that a railroad traveler who had "five minutes for refreshments" undertook to call for a plate of "saucissenkartoffelbruchsauerkrautkranzwuurst," and the train was at the next station, twenty miles distant, before he had half finished asking for the dish.

THE *La Plata Miner*, published at Silverton, Col., says: San Juan has abundance of carbonate ore. On the head of the Dolores there are a dozen good carbonate mines already being worked. On the Howard Fork there are several mines which carry

carbonates that will compare favorably with the very best mines at Leadville, and they have the advantage over Leadville of being well defined veins. A discovery was made of a carbonate lode of twenty feet in width on the Howard Fork this week. Assays from the surface show twenty to forty ounces in silver to the ton.

Harper's Magazine for July presents the following attractive table of contents: Narragansett Pier, Prof Charles Carroll, with fifteen illustrations; The Owl Critic, a poem, James T. Fields, with two illustrations; The Land o' Burns, William H. Rideing, with fifteen illustrations; The Mowing, a poem, S. H. M. Byers, with one illustration; A Peninsular Canaan, III. Delaware, Howard Pile, with nineteen illustrations; The Happy Island, a story, Edward Everett Hale; A Romance of Easthampton, A. A. Hayes, Jr., with three illustrations; The Storming of Stony Point, H. P. Johnston, with three illustrations; Fifty Years of American Art, I., S. G. W. Benjamin, with thirteen illustrations; Young Mrs. Jardine, Dinah M. Craik, with three illustrations; Recollections of Charles Sumner, E. P. Whipple; The Diary of a Man of Fifty, a story, Henry James, Jr.; Editor's Easy Chair; Editor's Literary Record; Editor's Scientific Record—Astronomy, Physics, Anthropology, Zoölogy, Engineering and Mechanics; Editor's Historical Record.

The following are the contents of the *Atlantic Monthly* for July: Massy Sprague's Daughter; Glamour, William O. Bates; Public Balls in New York; The People for Whom Shakespeare Wrote, II., Charles Dudley Warner; Recent Modifications in Sanitary Drainage, George E. Waring, Jr.; Juno Ludovisi, Hjalmar Hjorth Boyesen; Irene the Missionary, XIV.-XVIII.; The Morning Hills, Maurice Thompson; Our Commerce with Cuba, Porto Rico, and Mexico, C. C. Andrews; The Children Out-of-Doors, John James Piatt; A Fossil from the Tertiary, Edward E. Hale; Avalanches, H. H.; English Skies, Richard Grant White; The Contributor's Club; Recent Literature; Education.

The contents of the *Popular Science Monthly* for June are as follows: Condition of Women from a Zoölogical Point of View, I., by Prof. W. K. Brooks; Selecting a First Meridian, by E. Cortambert (illustrated); The Study of Physics in the Secondary Schools, by John Trowbridge; Modorn Science in its Relation to Literature, by William Brackett; Observations on the Chameleon, by O. R. Bacheler, M. D.; The United States Life-Saving Service, by W. D. O'Connor (illustrated); Diseased Condition of the Faculty of Wonder, by Professor Gairdner; Are Explosions in Coal Mines Preventable? by Francis R. Conder, C. E.; Chemistry in its Relations to Medicine, by Professor Ira Remsen; The History of Games, by Edward B. Taylor, F. R. S.; Whales and their Neighbors, by Dr. Andrew Wilson; A Problem in Human Evolution, by Professor Grant Allen; Sketch of Professor Clifford (with portrait); Correspondence; Editor's Table; Literary Notices; Popular Miscellany; Notes.

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